Food and Agriculture Organization of the United Nations

FISH4ACP
Unlocking the potential of sustainable fisheries and aquaculture in Africa, the Caribbean and the Pacific

Tuna container loader feasibility study in the Marshall Islands

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Cover photograph: (c) Francisco Blaha

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Acronyms

ACP	Africa, Caribbean, and Pacific
ADB	Asian Development Bank
CA	competent authority
DWFN	distant water fleet nation
FAO	Food and Agriculture Organisation of the UN
FFA	Pacific Island Fisheries Forum
FSM	Federated States of Micronesia
FV	fishing vessel
IA	implementing arrangements
LTFV	Luen Thai Fishing Venture Ltd
MELL	Mariana's Express Line
MIMRA	Marine Islands Marine Resources Authority
PICs	Pacific Island Countries
PII	Pacific International Inc
PNA	Parties of the Nauru Agreement
PNG	Papua New Guinea
PS	purse seine
PSM	Port State Measures
RMI	Republic of the Marshall Islands
PMU	project management unit
RSW	refrigerated seawater
SKJ	skipjack (tuna)
ULT	ultra low temperature
VC	value chain
VCA	value chain analysis
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean
YF	yellowfin (tuna)

Glossary of terms

Containerisation	An operation in which tuna is unloaded from a fishing vessel (FV) and then loaded into refrigerated containers and exported. The loading of fish from a cold store into containers can also be referred to as containerisation, but most commonly as "container loading", and is not the focus of the report.
A landing	The offload in port of fish from a vessel to a wharf irrespective of where the fish unloaded is destined. Fish being containerized is by definition fish which has been landed.
Transshipment	The Western and Central Pacific Fisheries Convention (WCPFC) defines transshipment as "the unloading of all or any fish on board a fishing vessel to another fishing vessel either at sea or in port." The practice of containerizing and declaring it as a "transshipment" which currently takes place by some countries is contradictory to the Western and Central Pacific Fisheries Commission (WCPFC) Convention [1] and the European Union Catch Certification Scheme regarding section 7 (transshipment in port)[2] as both regulatory frameworks clearly state transshipment as a ship-to-ship operation. Fish landings are thus distinct from transshipments.

[1] WCPFC 2013. "Convention on the Conservation and Management of High Migratory Fish Stocks in the Western and Central Pacific Ocean" (2013), https://www.wcpfc.int/convention-text.

[2] Council Regulation (EC) No 1005/2008 of 29 September 2008 establishing a Community system to prevent, deter and eliminate illegal, unreported and unregulated fishing, amending Regulations (EEC) No 2847/93, (EC) No 1936/2001 and (EC) No 601/2004 and repealing Regulations (EC) No 1093/94 and (EC) No 1447/1999. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32008R1005

Executive summary

FISH4ACP is an initiative of the Organization of African, Caribbean and Pacific States (OACPS) to support sustainable fisheries and aquaculture development. The five-year value chain (VC) development programme (2020-2025) is implemented by the Food and Agriculture Organization of the United Nations (FAO) with funding from the European Union (EU) and the Germany's Federal Ministry for Economic Cooperation and Development (BMZ).

The purse seine tuna value chain in the Marshall Islands is one of 12 value chains (VC) competitively selected from over 70 proposals worldwide for support from the FISH4ACP programme. An upgrading strategy for the tuna VC was agreed with stakeholders during 2021 and is being implemented with support from the FISH4ACP programme.

The proposed strategy has four major elements:

1. *Increased containerisation of purse seine caught tuna for sale to canneries (or traders)* primarily in whole round frozen form having been sorted/graded, but potentially also following processing onshore into loins. This element exploits Majuro's position as a major hub for transshipment with large volumes of raw material flowing through Majuro port, to attract an increased proportion of existing catch that is currently transhipped to be containerized.
2. *Increased landings in* the Marshall Islands*, enabled by an approved and functioning Competent Authority (CA) and resulting in increased exports*. A CA is critical to allow fish landed in the Marshall Islands by the Marshall Islands and non the Marshall Islands flagged vessels to enter the European Union markets (via canneries to which vessel owners sell their catch), as fish landed in Majuro is considered as having its 'origin' from the Marshall Islands. Improvements in the fish hygiene and food safety standards of the private sector operators running fishing vessels and onshore facilities in the Marshall Islands will also be necessary.
3. *Greater levels of storage and sorting of tuna in* the Marshall Islands *prior to export, facilitated by increased cold storage capacity*. Facilities would enable catches to be landed, sorted and stored in the Marshall Islands prior to export in containers, and potentially for container stuffing to be completed in a temperature-controlled environment. However, costs of construction and operation of such a cold store could be considerable and have not been fully explored during this preparatory phase of the FISH4ACP project, and the viability of this component thus remains uncertain.
4. *Social and environmental sustainability improvements* to be realised through addressing the most critical 'hotspots' identified in the social and environmental sustainability assessments.

This report presents a feasibility study of investments in tuna loading machines which could be used in the Marshall Islands to load fish from fishing vessels into containers. It falls under component 1 of the upgrading strategy. The report is based on work undertaken by two FAO consultants, Francisco Blaha and Keith Flett who were commissioned to look respectively at the operational and financial feasibility of mechanical container loading machines. The report takes the outputs of both consultants and merges their work into a single report, further informed by ongoing discussions possible mechanisms for structuring the funding of the machines to be procured.

Key findings, conclusions and recommendations from the report are that:

- Containerisation will be complementary to the carrier/transsshipment trade, which will be, for the foreseeable future the key activity in Majuro. Carriers will continue due to the other benefits they generate (bringing supplies, salt, parts, crew, etc)
- Based on the regional experience (Kosrae and Noro), the success of containerisation is predominantly based on the operator having a unique and solid partnership with container shipping operators.
- The use of loaders has the main advantage of making the process faster, which has many domino-type effects on the vessel's ability to complete unloading faster and the tuna's thermal efficiency and transport quality.
- It is important to have all the spares and supplies needed to be on hand to use when needed and the operator having established in-house workshops.
- The South African-made star loaders are the region's most widely used loaders. Noro has derived great benefits of them.
- Star loaders are good for loading containers, but they are not designed to sort tuna, and they are not vital for the operation of a cold store.
- The recommended model is the Mark 2 and from an operational perspective it makes sense to have 2 loaders on site. However, given the investment costs of the machines, and the fact that it will take time to gradually increased containerisation in the Marshall Islands, the financial analysis has shown that investing in one loader only initially would be viable.
- The private sector is unlikely to invest in a star loader without public financial support given the risks and capital outlay involved. However, from an economic perspective, the use of loaders to support containerisation in the Marshall Islands would generate broader social and economic benefits which could be transformative. This provides justification for public sector support to investments.
- Given the investment costs involved and FAO procurement rules which prevent FISH4ACP financing a loader for provision to Government/MIMRA, it is proposed that FISH4ACP finance around 60 percent of the investment cost of one star loader, with the private sector financing the other 40 percent. Exact percentages need to be agreed between the parties.
- The public sector financing would represent a subsidy of depreciation expense but in practical terms would be a cash contribution at the time of purchase.
- Given FISH4ACP financial contributions, and with ownership of the machine being in private sector hands, conditions should be placed on the private sector with regards to maintenance, wages paid to labour used, some trial use by other parties, and reporting. Again, the exact conditions need to be negotiated between the parties.

1 Introduction

This report contributes to the implementation of the FISH4ACP: Sustainable Development of Fisheries and Aquaculture Value Chains in ACP Countries (GCP/GLO/028/EC) project. The overall objective of this project is to contribute to poverty reduction, jobs creation, food, and nutrition security by improving the economic, social, and environmental sustainability of fisheries and aquaculture value chains in ACP countries.

In the Marshall Islands, FISH4ACP worked with stakeholders during 2021 to develop an upgrading strategy for the tuna purse seine value chain. The upgrading strategy will support the Marshall Islands' ability to support an increasing volume of tuna exports using containers, reducing the current reliance on transshipment. This hinges to a strong extent on the ability to improve the efficiency in loading containers (known as stuffing), thereby reducing costs and improving the quality of fish sold to canneries. This in turn is dependent on the acquisition, use and maintenance of new container stuffing machines. A more efficient containerization process should allow tuna to be sold to canneries at higher prices, with related onshore costs in the Marshall Islands being offset by those higher prices. This element exploits Majuro's position as a major hub for transshipment with large volumes of raw material flowing through Majuro port, to attract an increased proportion of existing catch that is currently transhipped to be containerized.

The report was prepared by the FISH4ACP project management unit (PMU) based on draft report outputs provided by two consultants, Francisco Blaha and Keith Flett, both of whom were contracted to provide inputs to activity 1.1.1 of the upgrading strategy, which is to prepare a feasibility study of investment in container loading/stuffing machines. The two consultants looked respectively at the operational and financial feasibility of investments in container stuffing machines. The report takes the outputs of both consultants and merges their findings and recommendations into a single report, further informed by ongoing discussions possible mechanisms for structuring the funding of the machines to be procured.

The aim of this report is to assess the technical and financial feasibility and possible investment arrangements (e.g. private sector, government and FISH4ACP contributions) for the loading machines to be used during containerisation, and to which FISH4ACP may contribute finance.

2 Containerisation and transshipment: an overview

2.1 Present status of containerisation in the region vs transshipments

MRAG 2019[3] suggest that 80 percent of purse seine product and 22 percent of longline product harvested in the FFA membership countries was transhipped on or near the fishing grounds. Poseidon 2022[4] report average annual volumes of transshipments by longline vessels in the

[3] MRAG, 2019. MRAG - WCPO Transshipment Business Ecosystem Study. https://mragasiapacific.com.au/projects/wcpo-transshipment-business-ecosystem-study/

[4] Macfadyen, G., 2022. Transshipment estimations. Poseidon Aquatic Resources Management Ltd Report

WCPFC convention area (excluding the overlap area with the Eastern Pacific Ocean) of around 100 000 tonnes a year and purse seine transshipments of just under 1 million tonnes a year. Macfadyen et al 2022,[5] noted the small quantity of catch landed and/or processed in the Marshall Islands for export (c.a. 15 000 Mt of containerized tuna products) compared to the large volume of catches being transhipped through the Marshall Islands (c.a. 360 000 Mt in 2019).

According to best practice port state measures (PSM), any fish leaving a fishing vessel while in the port area, either to be transhipped and/or landed, can only do so under the authorisation and monitoring of the fishery authority of the port state[6]. The next place of storage of the unloaded fish, whether a cold store, a processing establishment, or a container to be shipped, is irrelevant in terms of PSM best practices to be applied.

The volumes of tuna landed and processed in Pacific Island Fisheries Forum Agency (FFA) countries presently represent approximately 14 percent of total fleet catches within FFA waters. (FFA 2017[7]). The unloading from longline, pole and line. and purse seine operations to the wharf for loading into refrigerated containers (freight/shipping) is not *per se* captured in the regional statistics. MRAG (2019) suggests that it is less than 3 percent compared to the catch currently transhipped to carriers.

What is certain is that only a limited fraction of the total volume of the tuna caught in the region is landed in Pacific Island Countries (PICs), and an even smaller amount is containerized. Limited competitive onshore processing capacity and limited port facilities are the key reasons for this reality. Proximity to the raw material has yet to prove to be sufficient to generate an expansion of processing in the region (FFA, 2017), largely due to the costs of establishing and running canneries in small island developing countries where everything required for canning apart from the fish has to be imported. Macfadyen et al 2022[8] noted that tuna canneries in the region are limited to those in: Papua New Guinea, Solomon Islands, Fiji, and American Samoa. Country-specific and regional impediments include (but are not limited to) logistical issues, small domestic markets, lack of appropriate port infrastructure, market access issues, the lack of economies of scale, land availability and higher utility and other production costs.

2.2 Benefits of containerisation and container sizes

Landing, sorting, and containerisation are enticing for processors in destination countries (mainly in terms of processing planning and logistics), yet they also provide some benefits for the ports where it happens, as it provides employment opportunities and a chance to add value

[5] Macfadyen, G., Duong, G., Stege, M., Sahib, M., Bain-Vete, M., Gillett, R. 2021. The purse seine tuna fishery value chain in the Marshall Islands: Analysis and design report. Rome, FAO.
[6] FAO, 2017. Seafood traceability for fisheries compliance – Country- level support for catch documentation schemes. FAO Fisheries and Aquaculture Technical Paper No. 619. Rome, Italy. https://www.fao.org/3/i8183e/i8183e.pdf
[7] FFA, 2017. Economic and Development Indicators and Statistics Tuna Fisheries of the Western and Central Pacific Ocean
[8] Op. cit.

to catches through separating catches for sale to different canning markets which may have different requirements and thus be prepared to pay different prices. Furthermore, if unloading in a port with limited cold storage capacity and a well-established shipping schedule (such as Noro), this provides the vessel operators with an alternative to just transshipment.

If it is done under the framework of PSM, containerisation has the added benefit of facilitating monitoring by the port state authorities in terms of legality, but also includes better monitoring of volumes by species during unloading and logistics, since they have a maximum allowed capacity (23– 28 t, depending on the shipping company and destination).

The industry standard is 40ft refrigerated containers and based on the needs (purse seine or longline), they can operate from the regulatory requirements of -18C° down to -65C° in specially insulated containers.

The maximum weight to be loaded in a container has two determining factors, one being the shipping company internal policies, and the other being the limits for road transport in the country of destination. For example, none of the shipping companies allow (allegedly) more than 29 tons per container, yet Japan and Thailand have limits of 24 tons for the truck (so in practice, the cut-off point is around 23 tons). Ecuador and China, on the other hand are less stringent about product being received and allow up to 27 tons per container.

2.3 Why are carriers currently used more than containers?

With few processing facilities handling purse seine fishery in the region, transhipping is the predominant way to get the fish from the WCPO fishing grounds to the processing centres in Asia (Thailand, Viet Nam, Philippines) and Ecuador.

The big three trading companies (FCF, Trimarine and Itochu) charter carriers and place them in a few ports (Majuro, Pohnpei, Rabaul, Funafuti, Honiara, Kiritimati, and Tarawa) depending on shifting fishing grounds and licensing conditions. Some companies (mainly from Taiwan and the Republic of Korea) operate their carriers in conjunction with their vessels.

Of the over 230 carriers on the WCPFC Record of Fishing Vessels register above >1,000 GT, an estimated 140 are active in transhipping fish from the WCPO. Of these, over half are flagged to Panama. Of the remaining fleets, the Republic of Korea has the highest number of active vessels (owned by seven companies), followed by the Philippines and China.

Interestingly, it seems that the COVID-19 pandemic strengthened “transshipment in port” as a safe bet and may potentially incentivize investment in extending the life of the present fleet of carriers and the construction of new ones.

A tuna operator with more than 30 years in the industry, said: “If we did not have carriers, there would not be any canned tuna in the market by now. And if there is something we know in fishing, is not to have all your eggs in one basket, and with fishing vessels not allowed to land in most Pacific Island ports for over a year, containerisation was impossible, and we would have been in real trouble (Y. Lee, personal communication, 2021).

This view is coherent with statements in MRAG (2019) that most fishing companies, traders and carrier operators interviewed for their study reported that containers have had relatively little influence on the market to date, apart from squeezing margins from the old carrier business. Most thought that carriers would continue to be the dominant method of transporting fish to market for the foreseeable future. The most common reasons given for this view were that:

- Loading of containers can be 'fiddly' and time-consuming in the purse seine sector, with unloading to conventional carrier typically takes 3–4 days, while unloading to container typically takes 6–7 days. Given limited wharf space in many Pacific Islands, some interviewees also noted that fishing vessels unloading to containers would often be 'kicked off' wharf to allow higher priority container or bunker ships to unload. Ultimately companies saw this as a loss of fishing days and, therefore, money.
- Container facilities and logistical support are minimal in most Pacific Islands.
- The slower nature of loading containers also presents risks to the cold chain, and some companies reported having problems with the reliability of containers, leading to the rejection of fish at the processors.
- Scheduling is a problem in Pacific islands – because volumes are small, there is uncertainty about when fish can be delivered to market (by contrast, dedicated conventional carriers are a direct "door to door'' services). The lack of 'backfilling' opportunities would also undermine the economics of container carriers.

A further aspect seldom addressed is that carriers also have a fundamental role in providing goods and parts to fishing vessels (*i.e.* food, mechanical parts, oil, salt, foaming and cleaning agents, ropes, cabling, net components, fishing gear, etc.). Using salt as an example, FFA (2021)[9] reports the use of an estimated annual use of 140 000 tonnes of bagged salt is used by the purse seine fleet in the FFA Membership (with the qualification that these are conservative numbers). Salt is delivered to purse seiners by carriers at sea, before or during transshipment. As a reference point, the number of containers needed to transport this volume into the PICs using an average weight limit of 20 tonnes per container is 7 000 containers. This figure is substantially more than the present annual total number of containers handled by most ports in the FFA membership.

Carriers also have a fundamental role in crew rotation and replacements on the fishing fleet. Since it is substantially cheaper to have a crew as passengers on carriers to meet the vessels in the high seas or in port than to fly them to the Pacific Islands, this extends to visa issues since the gateways for flights to Pacific Islands are the United States of America, Australia and New Zealand that require transit visas for most South East Asian nationalities, which are expensive and difficult to get.

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[9] FFA, 2021. An assessment of fishing vessels plastic waste generation in the WCPO region, and potential measures to improve waste management in the fleet. https://www.ffa.int/node/2569

On the other hand, and as mentioned above, landing, sorting (if possible), and containerisation are enticing for processors in destination countries (in terms of processing planning and logistics), yet they also provide some benefits for the ports where it happens, as it provides employment opportunities.

2.4 Comparative transport costs for fish in containers and transshipment

The costs of shipping fish in reefer containers as compared to shipping fish by carriers to cannery locations is of critical importance for the practice of containerisation. Prices vary according to location, the availability of containers (which can be problematic in most ports in the Pacific given the relatively small amounts of frozen inbound cargo and which can therefore require sending in empty), plus changing and fluctuating rates of third-party shipping companies needed to move containers from the endpoint of shipping company routes to the ports where the canneries are, do impact the success of the practice fundamentally.

Macfadyen et al (2022) [10] analysed the typical costs of shipping containers from Majuro (excluding all shore-based costs of stuffing containers, plug-in etc.)[11] to canneries in Thailand and Indonesia. These are estimated to be in the order of USD 200-275/tonnes. Over 2018-2021, the cost of shipping a 40ft container from the Marshall Islands to both Bangkok and Jakarta by the Mariana's Express Line (MELL) ranged from USD 5 000 to USD 7 000. An average/typical cost was USD 5 500 (i.e. USD 211 per tonne if containers are stuffed with 26 tonnes, or USD 275 if only 20 tonnes are in a container). Other indications are that shipping costs (excluding all shore-based costs) may typically be USD 300– 350/tonnes. The cost charged by container carriers for the transport of fish to canneries in Thailand and other main destinations also varies for macroeconomic, geographic, and seasonal reasons. But in summary, the cost ranges from 240 to 350 USD per ton, excluding shore-based costs.

Some of the onshore costs (March 2023) in the Marshall Islands of containerisation are as follow:

[10] Macfadyen et al, 2022 op cit.
[11] But including insurance premiums that shipping companies pay to their insurers which are built into shipping costs, and which in turn are.

TABLE 1: SELECTED ONSHORE COSTS IN THE MARSHALL ISLANDS RELATED TO CONTAINERISATION

Item	Cost (USD)
Precooling of container	75-85 per container
Loading charges (people, platform, etc)	10-20 per Mt
Movement of containers in yard	160-200 per container
Plug in one full	75-85 per day per container
Port and stevedore clearance	330-360 per container

Source: Authors' own elaboration.

2.5 Port requirements for transshipment and containerisation

Even if a port is suitable for transshipments this does not necessarily mean that is also appropriate for containerisation, since they require a different set of facilities. A suitable transshipment port can be a protected and spacious lagoon, with good anchorage ground and not much in terms of services, as is the case of Funafuti in Tuvalu, while a port for containerisation requires all the attributes of an operative commercial port able to receive container ships.

Majuro itself is an excellent transshipment port due to two main characteristics:

Proximity to fishing grounds: Distance from fishing grounds to where carriers are available is an important factor, as the tuna trading companies attempt to place carriers in locations convenient to purse seiners based on current fishing conditions, as it is in both parties' interests to complete transshipment as soon as possible after the purse seiner leaves the fishing grounds. Yet specific needs arising from the fishing trip, the sale of the catch, the logistics involved, and the preferences of masters and vessel managers may dictate the use of another port, even if it is further from the ground.

Safety of anchorage: the safety of the vessels is the ultimate responsibility of the master of both fishing vessels and carriers. As transshipment occurs on the anchorage of the carrier a good solid ground for anchoring is key to the carrier that often has two purse seiners transhipping at the same time (one on port and one on starboard) and all depending on the carrier's anchor, hence no dragging is paramount. Furthermore, dragging is a consequence of wind and swell exposure, therefore the more protected the anchorage area the better. Therefore, enclosed lagoons would always be preferred over open ones.

Other factors are also important for fishing vessel masters in deciding where to tranship, and to varying degrees play a positive but lesser role in Majuro being an attractive location for transshipment:

Access to shore: having easy access to a wharf near the main facilities in town for crew influences a master's choice. These facilities compromise not only food and entertainment but access to local SIM cards with affordable data plans for the crew to communicate with family.

Services access: purse seiners and carriers are complex vessels, there is an incredible amount of machinery and technology that needs parts and maintenance: from propulsion to electricity generators, to hydraulics, to refrigerate 900 tons of fish, to maintain the electronics, etc. While most repairs are done on board, if land-based services are needed the preference would always be to those ports to have access to well-stocked and capable staff ready to support a rapid turnaround.

Health facilities on shore: While the evacuation of a critically injured crew member is governed by maritime and crew welfare rules, in non "life or death" situations most masters will have no qualms in steaming 24 or 48hs more to get the crew to the port offering the better facilities.

Flights frequency and connections: a need for frequent and varied international air travel connections for key personnel.

Costs: Cost is an important factor for vessels managers. Charges levied for anchorage, berthing, pilot, line agencies, and transhipped volumes fees, have a supplementary influence on transshipment port choice, although more expensive ports may offset any negative influence of costs by emphasizing better services, observers, etc.

Net Yard: Like any other onboard gear, nets require maintenance and different level of repairs and replacement. The reasons for repairs vary, yet common causes are wear and tear, severe weather, accidents, bad manoeuvring, the release of an accidental capture, gear failures, etc.
As a commercial port able to receive and operate with container vessels, Majuro (as many other ports in the region) faces a set of unique challenges beyond the lack of dock space and limited space for increased operations.

In 2020, ADB [12] discussed unique challenges in the Pacific ports in terms of regional characteristics and common operational and logistical port obstacles that impact trade and thus the presence of container shipping lines, and which may also impact on transshipment operations. Some of the challenges that apply to Majuro include:

Remoteness: Majuro's closest main ports are Honolulu, 2,282 nm to the north-east, Tokyo is 2 810 nm to NW, and crucially 4 850 nm to Bangkok and 18 384 nm to Manta as the key tuna ports. This remoteness impacts transportation costs due to fuel consumption but also results in costly operations in securing spare parts and maintenance for core port assets and inefficiencies in the logistics system.

Low cargo volumes and availability of container shipping lines: The volumes of container traffic in the region are low and linked to small populations and therefore low demand. Container shipping lines have a fixed route and drop cargo off at every port of call. An additional problem is the available draft that prohibits the use of larger container vessels in many countries. The low economies of scale contribute to costly operations for shipping lines. Macfadyen et al

[12] ADB, 2020. Smart Ports in the Pacific. https://dx.doi.org/10.22617/TCS200293-2

(2022)[13] noted that there are only three main shipping lines running container ships in/out of the Marshall Islands (see later discussion):

Multipurpose docks and wharves: Majuro's Delap wharf is multifunctional, requiring facilities to import not only containers but also general cargo, bulk, liquids, and vehicles. It can also serve fishing vessels and cruise ships, posing additional challenges to efficient and safe operations for passengers and cargo.

Reliance on imported fuel: Majuro is heavily reliant on the import of fuel, which comprises a large share of its imports. Governments have stepped up efforts to scale up renewable energy projects to mitigate fuel costs and climate change impacts. The large energy costs and increasing renewable energy efforts create an environment that promotes the electrification of port equipment and the implementation of renewable power for ports. Yet freezer containers are major consumers of electricity and require reliability.

3 Containerisation practices and ports used by the purse seine fleet

3.1 Introduction

Purse seiners (PS) fishing in the WCPO can only tranship in port as Parties of the Nauru Agreement (PNA) Implementing Arrangements[14] and in accordance with WCPFC transshipment conservation and management measures. [15] PS catches, therefore, also represent a potential for containerisation when vessels come to port.

Tuna for canning from the purse seiner fishery is a bulk commodity, with any price differences determined primarily by species and size and then by quality. The ability to differentiate species is usually a result of fishing set-up, with catches made on free schools likely to contain larger fish and fewer juvenile yellowfin. There is little premium paid for size until you get to larger fish for premium species, and in general terms, this means yellowfin above around 10 kg.

In PS fisheries, containerisation normally occurs without grading into species or direct weighing of fish, which are only estimated through good approximations, and are generally obtained when containers reach capacity. Yet theoretically this offers some opportunities to sort catches by species, either on board or during unloading, thus enhancing the opportunity for diversified marketing.

Once onboard after being caught, tuna is passed below deck to be loaded into wells. Bigger vessels employ chute systems, while others, use conveyor belt systems to direct catch into the desired wells. Tunas in PS are chilled whole in refrigerated seawater (RSW) without bleeding, removing the gills or gutting, and then subjected to brine immersion freezing. This technique

[13] Op. cit.
[14] https://www.pnatuna.com/implementing-arrangements
[15] Conservation and Management Measure (CMM) on the Regulation of Transshipment, 2009-06. https://cmm.wcpfc.int/measure/cmm-2009-06

involves storing fish in brine (made by adding salt to seawater) and reducing the brine temperature until the fish (but not the brine) are frozen.

Freezing such a large number of fish requires potent freezing equipment and high-volume wells, which occupy much of the lower part of the vessel and are equipped with batteries of pumps for brine and RSW circulation. In the larger vessels, there are also “dry or side lockers” that work as an “additional freezer” where already brine frozen fish is stored “dry” (*as without brine*). Newer vessels also have specially adapted “dry lockers” that act as blast freezers for higher-value species, like those in longliners LLs that can freeze and maintain catch to -35C.

This section describes the processes and steps involved once fish brought into port for containerisation.

FIGURE 1. CONTAINERISATION FROM A PURSE SEINE ON THE WHARF

Source: © Francisco Blaha

3.2 Containerisation processes

3.2.1 Offloading from vessels

Once a PS comes to wharf side and is tied up, it can take a while until unloading is authorised, depending on the level of inspection and regulatory steps required. Once landing is authorised, the following steps take place:

From well to deck

The lifting of the tuna out of the wells can have two distinctive methods for:

1. Dry fish: This is the most common way of unloading for transshipment and landing. In traditional unloading the brine is pumped out of a well, and the hand expansion valves are turned off an hour or so before the start of unloading. If a well is not packed too tightly, the salinity of the brine used for brining and re-brining and the temperature in the wells are correctly adjusted, the unloaders should be able to “hook” the fish loose from the mass of frozen fish and loaded into the cargo nets to the deck. Increasingly tuna is classified by species before loading into the net, and then sent up in separate nets, and/or further are separated on deck and put in different nets before unloading. In newer vessels, frozen fish from the wells is removed during the finishing trip and stored in the dry/side lockers that are never brined. Tuna is stored separated by species; the unloading process works on the same principle as the nets.
2. Wet fish. Fish are often unloaded by the “floating ”ff" method when they are to be transhipped. Under this procedure, the brine is left in the well during unloading. As soon as individual fish separate from the mass of fish, they float to the top of the well since the brine has greater specific gravity than the fish. Long-handled hooks are used to separate the fish. The floating fish are taken out of the wells, moved via conveyor belts or chutes straight to shore, and put in cargo nets, hoisted from the hold to the deck. The wet fish method is often used when the unload goes straight into bins for processing or storage, and under the right circumstances when allowing for drip time, can be used for containerisation. Without drip time, the ability to stuff them into a container ‘s 'wet fish” is lower, as at the destination port fish is frozen together as a block in the containers, taking more time to unload and resulting in higher rejects from broken fish.

The well and deck hatch size is particularly important because the size of the hatches on deck is the limiting factor in terms of the speed of unloading. This is due to the volumes of fish that fit in a net that comes from the well, through the hatch onto the deck, as shown in the pictures below:

FIGURE 2. WELLS HATCH SIZE AS LIMITING FACTOR ON UNLOADING VOLUMES

Source (c) Francisco Blaha

FIGURE 3. CARGO NET TROUGH THE HATCH SIZE AS LIMITING FACTOR ON UNLOADING VOLUMES

Source: (c) Francisco Blaha

There is no exact rule for the volumes coming out at once, yet older vessels with up to 1 000 ton carrying capacities such as those of Taiwanese and Japanese origin, have nets with 700 to 800kg being brought at once. Newer American, Korean, and the United States of America, -made vessels cap at arou–d 1 500 - 1 700 kg while the bigger European vessels cap lift up to 2 500 kg at once.

From deck to wharf/pier

Once fish is in cargo nets on the deck of the PS, it is hoisted by one of the vessel cranes or by a shore based one, straight to the wharf or to a platform at the wharf, either using one of th' vessels' own winches or a shore-based crane.

FIGURE 4. CONTAINERISATION FROM A PURSE SEINER IN WHARF WITH SPECIES SEPARATION TO EACH CONTAINER

Source: (c) Francisco Blaha

3.2.2 Onshore stuffing and management of containers

Loading (stuffing) of containers

This is a mostly a manual operation despite the different levels of mechanization available for loading. It involves stevedoring staff at the wharf, platforms and inside the containers, requiring regular breaks and staff rotation.

Stuffing a container manually with fish can take around 2 to 4 hours, depending on:

- The weather (unloading is always suspended when it rains as it “wets’ the fish and the whole operation becomes more slippery and therefore unsafe for operators)
- Quantity and experience of stevedoring staff

- The use of different types of chutes or conveyors to move fish into the container.

This compares with the ability of more sophisticated mechanical loaders able to stuff a full container within one hour.

The working hours for labour correspond to those of the unloading vessel, usually 7am to 10pm with various breaks for food. Yet in some cases, if the unloading is done with a contracted unloading crew, the process can be done over 24 hrs, yet this is unusual.

Controls by the fisheries authority normally take place during this stage (either officers or unloading monitors depending on the port state set up) and include assessing volumes, estimating species composition, and species of interest, etc. Representatives of both the unloading vessels and those responsible for the containers are also part of these controls since accurate weights per species are key for crew payments and insurance premiums for the shipping of the containers.

Figure 5. Stuffing with "sorted on wharf "skipjack straight off the vessel after an authorised landing

©

Source: (c) Francisco Blaha

Efficient shore storage logistics are fundamental since unloading from the vessel is a time-constrained operation and requires enough precooled containers and at least a loaded container lifting/moving machine and depending on the distance to the plugging points, container moving trucks, etc.

Once containers are fully loaded, they are moved to the electrical connection “plug in” points able to provide 360– 500 Volt, 50 or 60 Hz for the refrigeration units to freeze down the tuna to at least -18°C. The cooling down of fish can take many hours depending on the general temperature of the loaded fish and the "stuffing density,’ as cooled air speed, and circulation are dependent on space in-between individual fish. Containers need to reach the set temperature range specified by the shipping company before the container ship will allow them to be loaded.

Shore storage and container loading logistics

Reliability of industrial power supply (360– 500 Volt) is fundamental for storage, and this has historically been a problem in the region. ADB (2019)[16] reports that the Pacific region faces a unique set of electricity challenges. Its limited supply of domestic fossil fuel resources has led to a historical dependence on imported fuels for power generation, and a corresponding vulnerability to fluctuating energy prices. At the same time, outdated power infrastructure, geographical dispersion, small economies of scale, and limited generation capacity lead to high electricity tariffs (or costly subsidies), transmission and distribution losses.

Van Duin et al (2019)[17] report that refrigerated containers are responsible for 40 percent of the total energy consumption of container terminals, when connected to the electricity grid on shore. Every time when many reefers are plugged-in after arrival, peaks in energy consumption occur.

While power consumption is high after plugging in, once the cargo has been cooled to low-temperature mode (below -10°C) the refrigeration unit is run in on/off mode, hence the average power consumption falls. Yet, power consumption per container is affected by environmental variables such as ambient temperature, wind speed and the level of direct sun exposure of the container. CHB[18] (2021) report that a 40' refrigerated container set at -21C and operating at an ambient temperature of 37.8°C, has average power consumption values of approximately 5.3 to 4.5 kW according to the type of refrigeration unit used.

Container ships operating to most Pacific ports are self-loading (*they have their own container loading cranes on board*) and operate on tight schedules allowing 12– 24 hrs operations per port.

[16] ADB, 2019. Pacific Energy Update. https://www.adb.org/sites/default/files/institutional-document/545686/pacific-energy-update-2019.pdf

[17] Van Duin *et al.* 2019. Factors causing peak energy consumption of reefers at container terminals. *J. shipp. trd.* 4, https://doi.org/10.1186/s41072-019-0040-y

[18] CHB. 2021. Container Handbook. German Marine Insures organization. https://www.containerhandbuch.de/chb_e/index.html

Therefore, the port container logistics need to be efficient and involve the agents and all line agencies (port authority, customs, pilots, biosecurity, immigration, etc.).

Containers must arrive in sufficient numbers to be loaded uninterruptedly while minimizing temperature loss. The cargo vessel Chief Officer will check the minimum temperature once containers are plugged in onboard and containers out of the temperature range are rejected. Shipping agents and exporters need to have all documentation ready and approved, i.e. load list for all containers and verified weights per container, shipping instructions (*with individual container identification*), bills of lading, export permits, and depending on the jurisdiction and destiny specific clearances related to drugs, biosecurity, bioterrorism.

3.3 Container ports in the region

The main ports where the containerisation of PS catches takes place in the region are Kosrae (Federated States of Micronesia, FSM), Noro (Solomon Islands), and Vidar/Madang, Lae, and Wewak (Papua New Guinea). Containerisation during La Niña events will naturally take place in the more western ports; yet during "normal' years, Kosrae, just 507 nautical miles from the Marshall Islands, is Majuro's closest competitor in terms of containerisation, hence the importance of knowing the situation there. This section provides some information on facilities and practices at both Kosrae and Noro

3.3.1 Kosrae

Since 2016, landing and containerisation have been taking place in Kosrae (one of the 4 states of the FSM). Despite its small population and limited accessibility, operations take place at the well-maintained commercial wharf, which has sufficient space for the unloading and storage of containers. The first operations there were in 2017 by Luen Thai Fishing Venture Ltd (LTFV)[19] , a Chinese tuna conglomerate that focused mostly on longline catches when it took over a small slipway for basic ship repair and an associated facility at the commercial wharf.

Soon Da Yang[20] (a Taiwanese / American company part of the LS Ocean Group) that owns FSM-flagged PS established operations at the wharf there. Da Yang is progressively budling a cold store and infrastructure for landing and containerisation of frozen purse-seine caught fish.

LTFV provides logistics services to PS vessels through its part ownership of the regional shipper Mariana Express Lines[21], with the other owner being Singapore-based Pacific International Li[ne] It is the 20th largest shipping company in the world and a large shipping container manufacturer that can provide custom freezer and cargo containers suited to LTFV and DaYang's needs. Their close association to a shipping conglomerate gives the operation a substantial advantage.

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19 LTFV currently operates bases in Majuro, Kosrae, Pohnpei, and Samoa.
20 http://www.dayangseafoods.com/we-believe-in-kosrae.html
21 https://www.mbjguam.com/2015/03/23/mariana-express-lines-purchased/

The containerisation operation run by DaYang is manual with the support of a feeding platform, taking a self-reported up to 2 hrs per container (J. Helgen, pers.comm.).

Electricity supply for the containers was a major issue in the past, so it required Da Yang to set up its own mobile power plant with 8 generators to maintain plug-in capabilities for 135 containers at the same time.

The volume of containers exported with PS products has been increasing since 2018 and is expected to reach 2 500 units a year on a continuing basis from 2021, which is believed to be the operational maximum for the combination of port infrastructure and shipping vessel frequency. The main destinations for containers are mainly to canneries in Thailand (70 percent) and Viet Nam (30 percent). The following quantities have been reported for Kosrae up to the end of 2021. (J. Helgen, pers. Comm.)

TABLE 2: ESTIMATED NUMBER OF CONTAINERS EXPORTED FROM KOSRAE BY PURSUE SEIN

Year	2019	2020	2021
	1 477	1 568	>2 000

Source: Authors' own elaboration.

3.3.2 Noro

Noro in the Solomon Islands has grown steadily due in large part to the government's support as a tuna hub. It is the only port in the Pacific that hosts a major tuna cannery, a base for purse seiner, pole, and line fleets, unloading and shipping services for longliners and for their Ultra Low Temperature (ULT) catches. With deep water wharfs and a well-protected bay, Noro has been a busy unloading port since 1985; uncharacteristically for the region limited PS transshipment has taken place over the decades and none over the last 4 years. Most of the Solomon Islands flagged PS fleet operates form Noro and vessels are the main users of the containerisation facilities, albeit also transhipping in other ports –mostly Majuro - the Marshall Islands and Rabaul - PNG) when fishing outside Solomons in the PNA waters. Other flagged vessels using the port are from FSM, the United States of America, Taiwan, and the Republic of Korea.

Containerisation has been pursued in Noro as a business venture between NFD (formerly the National Fisheries Development), Solomon Islands Ports Authority (SIPA) and Maersk Line. Noro is at this stage the main unloading port (to serve the cannery) and containerisation port in the region for PS vessels. Both Soltuna and NFD were part of the Trimarine tuna conglomerate that now belongs to the Bolton group in Italy.

Containerisation occurs in Noro's two wharfs: Kitano, shared by NFD (fishing company) and Soltuna (Cannery) and Noro port.

Kitano wharf is used for NFD's medium size (500 ton) PS vessels and has the advantage of sizing and sorting fish first as fish comes off vessel onto a fixed sorting conveyor, then packing containers based on customer requirements e.g. yellowfin (YF) only, or skipjack (SKJ) undersize only.

Noro Port uses a mechanical 'star loader' for larger domestic and Distant Water Fleet Nation (DWFN) PS vessels (>800 ton). This allows for a quicker unloading time, but no sorting unless this has been done on board the FV which increasingly happens, as some vessels separate larger YF onboard and pack these separately.

NFD runs the container yard with a capacity of 64 plug in points, plus another 100 (not all working) at the main wharf.

Approximately 300 containers loaded directly from PS vessels are dispatched from Noro on a yearly basis. The destination of the containers with PS fish are in order of importance: Thailand, Ecuador, Seychelles, Viet Nam, Colombia, and the Philippines.

The following quantities have been reported for Noro up to November 2021.

TABLE 3:ESTIMATED NUMBER OF CONTAINERS EXPORTED FROM NORO FROM PS, 2018 TO 2021

	2018		2019		2020		2021	
Wharf	Kitano	Port	Kitano	Port	Kitano	Port	Kitano	Port
No. of containers	36	0	97	194	72	115	194	96
Total	36		291		187		290	

Source: Francisco Blaha based on Cynthia Wickham, pers. comm.

3.4 Status of containerisation (and transshipments) in Majuro/ the Marshall Islands

3.4.1 Transshipments vs containers

Majuro port is the only designated port for transshipment in the Marshall Islands and a major regional hub for purse seine trans[22] identifies Majuro as the second busiest port in the world after Busan in the Republic of Korea based on the number of foreign vessel visits (1 168) and the first in the world in terms of foreign fishing vessel hold size (943 000 m^3). In 2019, there were 595 FV, including carrier, arrivals to Majuro of which 509 were foreign flagged. These vessels took part in 481 transshipments with a provisional total of 362 454 Mt transhipped.

[22] Hosch *et all*. 2019. Any Port in a Storm: Vessel Activity and the Risk of IUU-Caught Fish Passing through the World's Most Important Fishing Ports. Journal of Ocean and Coastal Economics: Vol. 6: Iss. 1.

Those levels of transshipment collapsed in 2020 due to COVID19, as Majuro port saw a 60 percent decline in transhipment operations. Although 2021 did not approach the levels of 2018 and 2019 when Majuro port averaged 426 transshipments per year, the rebound was nevertheless significant. A total of 297 purse seiners transhipped to carrier vessels in the lagoon or unloaded at docks for freezer container shipments, with a combined provisional tonnage total of 221,609 Mt in 2021.

The breakdown of the transshipments to carrier vessels and unloading at dockside for containerisation in 2021 was:

- 250 transshipments;
- 39 split transshipments and unloading to containers; and
- 9 unloading exclusively to containers.

Pan Pacific Fishing, Marshall Islands Fishing Venture and Pacific International Inc combined to export 11 291 Mt with containerized shipments making up most of the tonnage. Skipjack made up most of the tonnage with 6 824 Mt, yellowfin accounted for 3 648 Mt, and bigeye 819 Mt. Pan Pacific Fishing exported over half of this tonnage, shipping out 6 043 Mt during the year. The exports of whole frozen tuna went to Thailand, Viet Nam, Indonesia, Fiji, Japan, and Taiwan.

2022 saw very low levels of transshipments due to La Niña[23] with fishing effort being mostly and correspondingly based in the western side of the WCPO, with high activity in Papua New Guinea and Solomons. This low pattern of activity has extended into 2023. There were only 19 transshipments to March 2023, which is extremely low compared to transshipment data for the past 10 years, and there was no unloading to containers in the first 3 months of 2023.

Changes to the current balance between transshipment and containerization are likely to be driven by key actors in the downstream value chain in the form of trading companies. There are three large tuna trading companies operating in the WCPO, which purchase tuna that is containerised or transhipped in the region: FCF Co., Ltd. (FCF), Tri Marine Group and Itochu.[24]

3.4.2 Containerisation operators

Presently there are two actors in the containerisation set up in Majuro.

The Majuro Stevedore & Terminal Co (MSTC), a private company operating under a concession agreement with the Marshall Islands Ports Authority at the biggest dock in Delap. The company

[23] The distribution and abundance of tuna species is influenced by natural climate variability through the influence of climate drivers like El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) aka La Niña. During a La Niña, tuna populations are found more in the Western Pacific, and during an El Niño more in the Central and East Pacific.

[24] See Macfadyen et al, 2022, op. cit, for more information on these companies.

does not provide services to offload fish from PS yet allows for up to 50 reefer containers to be plugged in and the loading logistics once the container vessel arrives.

Pacific International Inc. (PII) is primarily a construction company that owns a large wharf, and it provides a range of marine, ship and gear repair and shipping vessel services, through the Majuro Net Yard. Since 2018 has engaged with containerisation, charging a fee of USD 55/tonne. The containerisation operation is quite basic, does not include sorting, and takes 2 to 4 hrs per container, involving 6 to 10 operators. Presently PII can only plug in a maximum of 7 to 8 reefer containers at a time for precooling and once stuffed, transports them to MSTC.

Most of the containers are used for skipjack and are sent to Thailand (82percent of container volume), with much of the larger containerised yellowfin destined for Viet Nam (10 percent by volume), with Ecuador, Taiwan, Papua New Guinea, and Indonesia accounting for the rest.

Taiwan is the flag state that uses Majuro most for both containerisation and transshipment, as the Marshall Islands recognises it diplomatically, followed by the Marshall Islands flagged PS (all Taiwanese-owned) and then vessels from the United States of America (with half of its fleet also beneficially owned by Taiwan), with Papua New Guinea and Nauru also important users of Majuro port.

3.4.3 Container shipping line logistics

Various shipping container lines cover different parts of the Pacific, with examples being Hamburg Süd, Matson Shipping, Neptune Pacific Line, Pacific Direct Line, Pacific Forum Line, So'frana, Mariana's Express Line, Kyowa Shipping Lines and Swire Shipping.

Macfadyen et al 2022,[25] considered the logistics and challenges of moving containers from Majuro to Thailand. There are only three main shipping lines running container ships in/out of the Marshall Islands, and all have agents based in Majuro: Mariana's Express Line (MELL); Kyowa Shipping; and SWIRE, a subsidiary of The China Navigation Company. These companies are of critical strategic importance to containerisation as they run the ships that do/would carry the reefer containers of PS-caught tuna from the Marshall Islands.

The commercial viability of any expansion in containerisation from the Marshall Islands is thus in part dependent on the shipping routes they operate, the availability of containers and frequency of vessel departures, and the transport costs for containerized fish compared to shipping tuna by carrier vessels to canneries.

MELL started fish containerisation in the Pacific in 2017, and works with both PS and longline catches, with Thai Union being its biggest customer/cannery destination. Reefer containers are maintained at -25C°. Its Micronesia service is of strategic value to the value chain as it takes in the Marshall Islands, and runs Guam, Federated States of Micronesia (FSM: Chuuk, Pohnpei, Kosrae), the Marshall Islands (Majuro and Ebeye), taking 1 to 2 weeks. Its South Pacific Service

[25] Op. cit.

(taking 6– 8 weeks) runs: Nansha (China), Hong Kong, Shekou (China), Lae (PNG), Honiaria (Solomons), Suva and Lautoka (Fiji), Majuro/the Marshall Islands, Kosrae and Pohnpei (FSM), and Nansha (China).

Kyowa runs a service taking in various ports in Japan and then Guam, Micronesia (Chuuk, Pohnpei, Kosrae), Papua New Guinea (Lae, Rabaul Port Moresby, Yap), and the Marshall Islands (Majuro, Ebeye, Kwajalein). It also runs a service from various China and various SE Asia countries through Busan (the Republic of Korea), and then to Guam, FSM, and the Marshall 'Islands.

SWIRE's Southbound service includes Majuro and runs: China (Kaohsiung, Tainjin, Qingdao), the Republic of Korea (Busan), Japan (Kobe, Nagoya, Yokohama), Kiribati/Tarawa, Solomons (Honiara), Vanuatu (Santo), Vanuatu (Port Vila), New Caledonia (Noumea), Fiji (Lautoka, Suva), Samoa (Apia), American Samoa (Pago Pago), and Tahiti (French Polynesia).

None of the options offers the chance for direct services to either Thailand, Viet Nam, or Manta in Ecuador, the main destination for PS tuna, which implies the need to tranship containers at feeder ports; this increases times, risks, and costs. In comparison, a carrier can take 2 or 3 weeks to reach these ports from the key ports of the region or the high seas.

4 Regional experience with container loading/stuffing machines

4.1 Introduction

This section presents practices and lessons learned from the use of star loaders used at Noro, Solomon Islands since 2016, and which is the main unloading port (to serve the cannery) and containerisation port in the region for PS vessels.[26]

It is important to recognize that container loaders do not themselves allow for sorting. Sorting requires a platform (Photo 6) or a purpose-built sorting conveyor with bins or some sort of container to separate the fish being sorted, either by species or by size (Photo 7). The fact that a tuna loader does have a conveyor belt to load containers does not mean that it can work as a sorting table with a conveyor belt, since if does not provide the height and space to have bins to hold the sorted fish sorted. As explained earlier, to a certain extent, sorting by species and size can be done on board, after brailling, and before arrival to port for those vessels with side lockers and/or on deck during unloading. To grade by size just off the vessel is better done on the wharf if fish is to be containerized manually and loaders are of limited or no use for this purpose.

[26] The authors acknowledge the generous support of Cynthia Wickham in providing her very useful input to this section.

FIGURE 2: PLATFORM SORTING

©Photo credit: (c) Francisco Blaha

Figure 3: Purpose-built sorting conveyor

©Photo credit: (c) Francisco Blaha

If the expectation of the local stakeholders is to do species sorting and size grading, then a set-up such as the one presented above is required. This report however focuses on container loaders.

4.2 Type of units and operational lessons learned

The use of "Star loaders"[27] has accelerated the efficiency in unloading times in Noro. Star loaders are the main type of tuna container loader used in the region (see Photo 8 and Photo 9 below) as well as in other main tuna ports such as Mauritius, Seychelles, and Kenya, and as such, are well tested internationally. Bennett's Engineering (Pty) Ltd based in Cape Town, South Africa, is the manufacturer of the loaders shown in the photos and figures below, having 20 years of progressive development experience in building and supplying them. The machines are produced in two main types: telescopic boom and fixed boom units.

Telescopic boom units
These are the industry standard; the images below are those operational in Noro.

FIGURE 4: MARK 2 TELESCOPIC BOOM LOADERS BEING CLEANED IN NORO

Photo credit: (c) Cynthia Wickham

[27] https://trimarinegroup.com/star-loader/

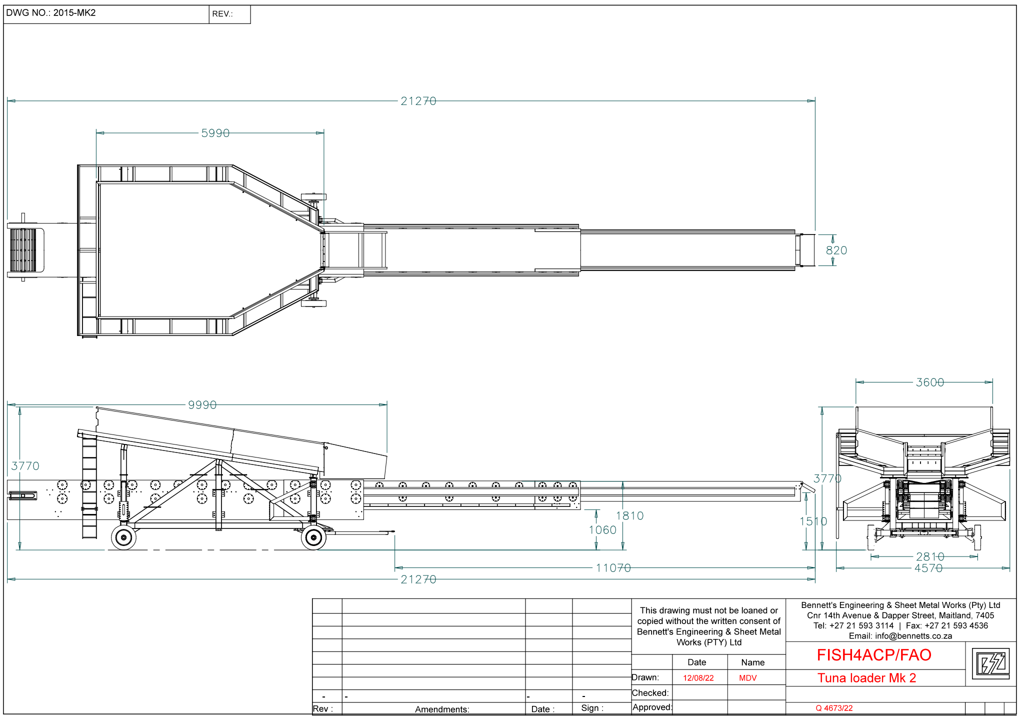
FIGURE 5: TELESCOPIC BOOM LOADER OPERATING IN NORO

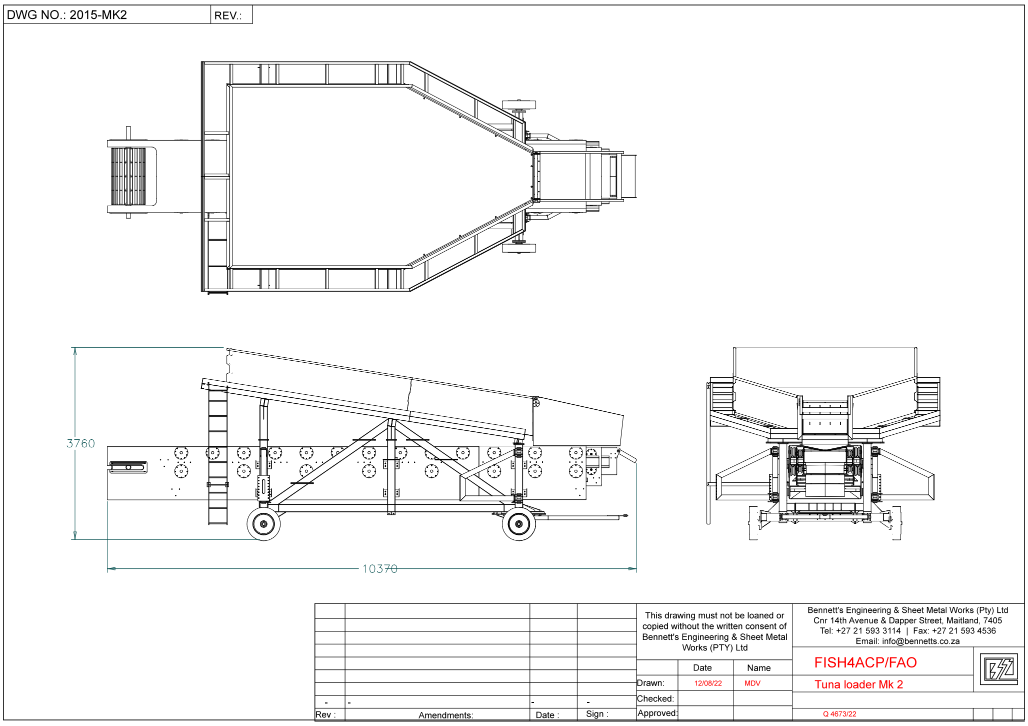
Photo credit: (c) NFD

The diagrams below are for the single boom Mk2 model. These units, with planned maintenance, have been operating in the field for 10 years.

This unit is fabricated in 316“stainless” steel, it has a "retracted" length of 10 m and takes up minimal space when not in use. The extended length is 21.2 m offering an excellent packing length in a 40ft container. Its final boom depth is “small” allowing much more " free" space for loading. This unit is powered by hydraulics and comes complete with power packs, controls, etc.

FIGURE 10. TECHNICAL DRAWINGS OF A TUNA LOADER MK 2 WITH TELESCOPIC BOOM





Source: Bennet's Engineering

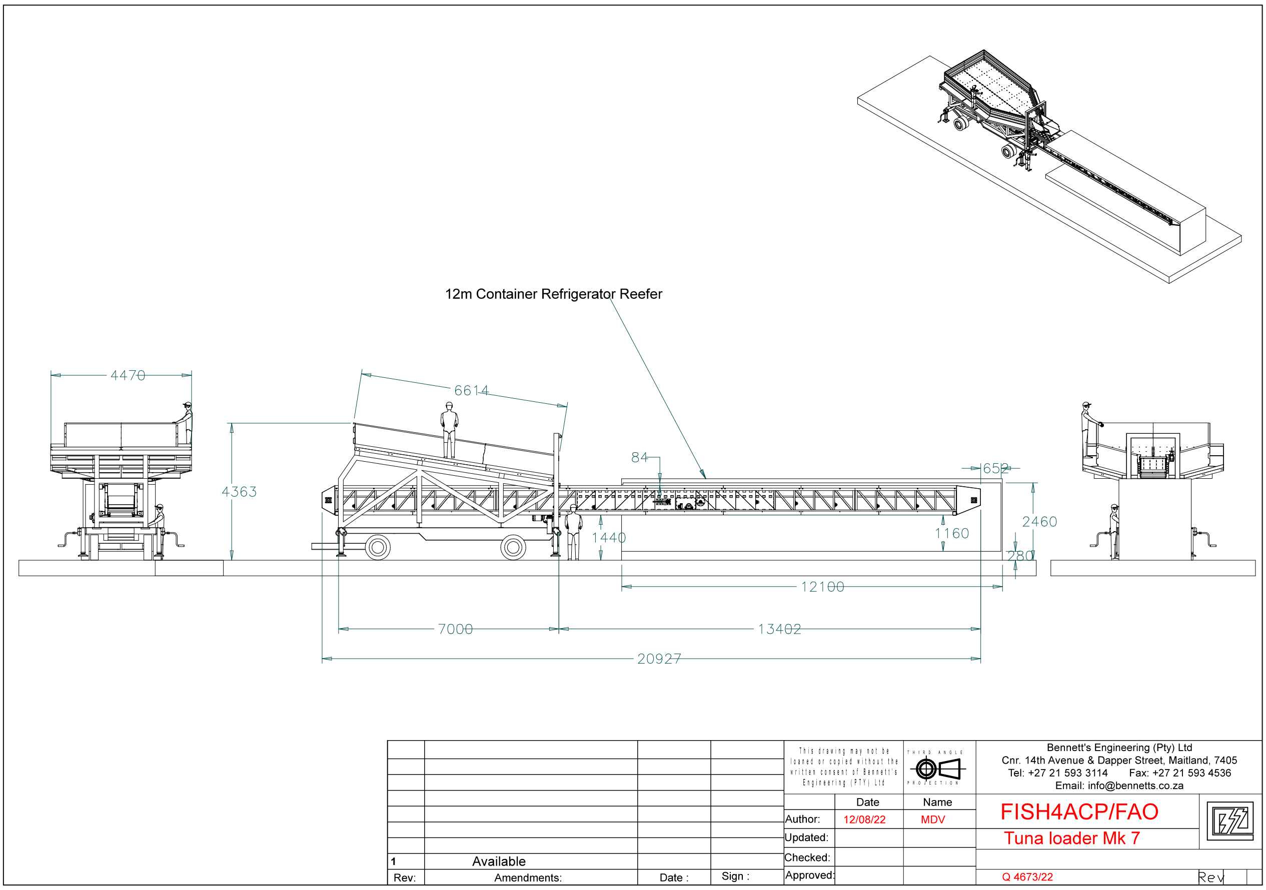
Fixed boom units

Fixed boom units involve less engineering in the manufacturing of the loaders, but require more storage space, and either moving the container or moving the loader outside/away from the container as fish starts to fill the container which can make the unloading difficult. As a result, this model is not generally the option preferred by the industry operators consulted in the Marshall Islands as part of field work used to complete this study.

Furthermore, while the conveyor trough and all parts in contact with the fish are in 316 stainless steels, the rest of the unit is fabricated in mild steel, which is hot dip galvanised and epoxy painted. These units therefore require more maintenance (and/or have a shorter lifespan) because when loading brine frozen tuna, over time the brine will degrade/corrode the steel.

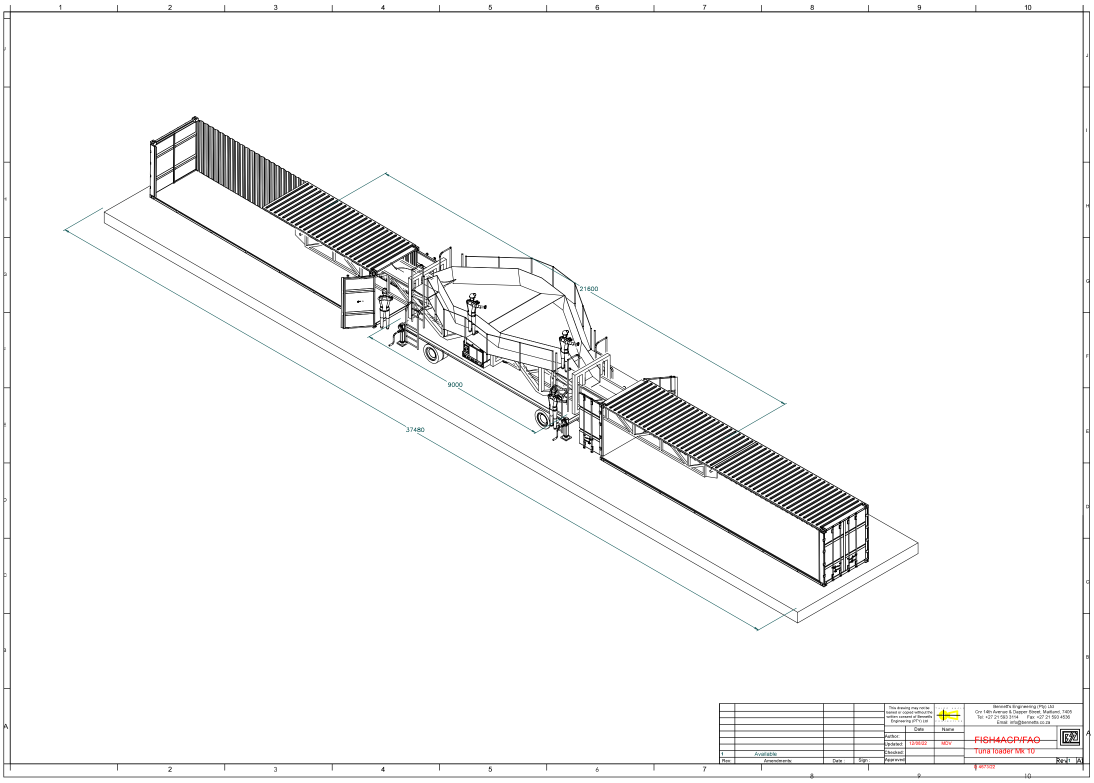
These units are electrically powered via geared motor units. Because of the "fixed" boom length of 18m the space required for the single boom and of 22. 5m for the double, the space required for the unit when not in use and when loading containers is substantially more than the telescopic unit and a larger port area is required.

FIGURE 11. TECHNICAL DRAWINGS OF A TUNA LOADER MK 72 WITH SINGLE FIX BOOM



Source: © Bennett's Engineering

FIGURE 12. TECHNICAL DRAWINGS OF A TUNA LOADER MK 10 WITH DOUBLE FIXED BOOMS



Source: © Bennet's Engineering

FIGURE 13: MOBIL TUNA LOADER MK 10 WITH DOUBLE FIXED BOOMS

Source: (c) Bennett's Engineering

4.3 Operational review of the units in Noro

Providing a sheltered area to park the units helps to maintain them against the elements, and a location with direct access to the unloading site is ideal. The telescopic loading boom, being able to be retracted, allows for both ease of storage where space may be limited and ease of mobility when positioning on the wharf.

FIGURE 14: MARK 2 MODEL LOADING UNITS UNDER SHELTER IN NORO PORTS AUTHORITY WHARF

Source: (c) Cynthia Wickham

Container stuffing without any delays from weather, mechanical issues, or unloading from vessel (i.e. sticky fish or sizing onboard) should average 1 hour per container (24~25mt fcl). One 1 000 Mt vessel can complete discharging within 4 days if there are no delays and based on 11-12 hours of loading a day with breaks.

To preserve the quality of fish as much as possible, break times need to remain flexible to complete the stuffing of a container unit and avoid partially full containers being moved twice during break times. Container stuffing works best when there is no sorting, or when any sorting has been done prior to unloading onboard (if such practice is possible). This is because the longer the container remains open the more moisture build-up occurs, which results both in ice build-up around fish when its temperature is brought back down on sealing the container, and which in turn affects the cooling capacity of the reefer containers and the quality of fish.

To avoid fish sliding out the container during operation, particularly when the container is close to being full, the conveyor is retracted towards the open doors, and a net panel is used to create a barrier or gate that remains inside until container door is closed (Figure 15).

FIGURE 15: FISH NET

Source: (c) Cynthia Wickham

Personnel

Four to five stevedores are required to operate the equipment during the unloading (one controlling the conveyor and three to four in the hopper), with another five in the container filling the fish (Figure 16). Other staffing needs are:

- A reefer technician who understands refrigerated containers to be on standby for any issues after plugging in full containers and continued monitoring after plug-in.
- A mechanic with hydraulics experience is required for the maintenance of the units. In Noro, the NFD vehicle and machinery workshop attend to any R&M of the stuffing units.
- A quality control staff may be optional if required by buyers to supervise unloading and monitor temperatures and unloading times.
- Other needs are a Klamar (container lifter) driver and container yard personnel and electricians.

FIGURE 16: BASIC OPERATION PERSONNEL

Source: Cynthia Wickham

Weighing

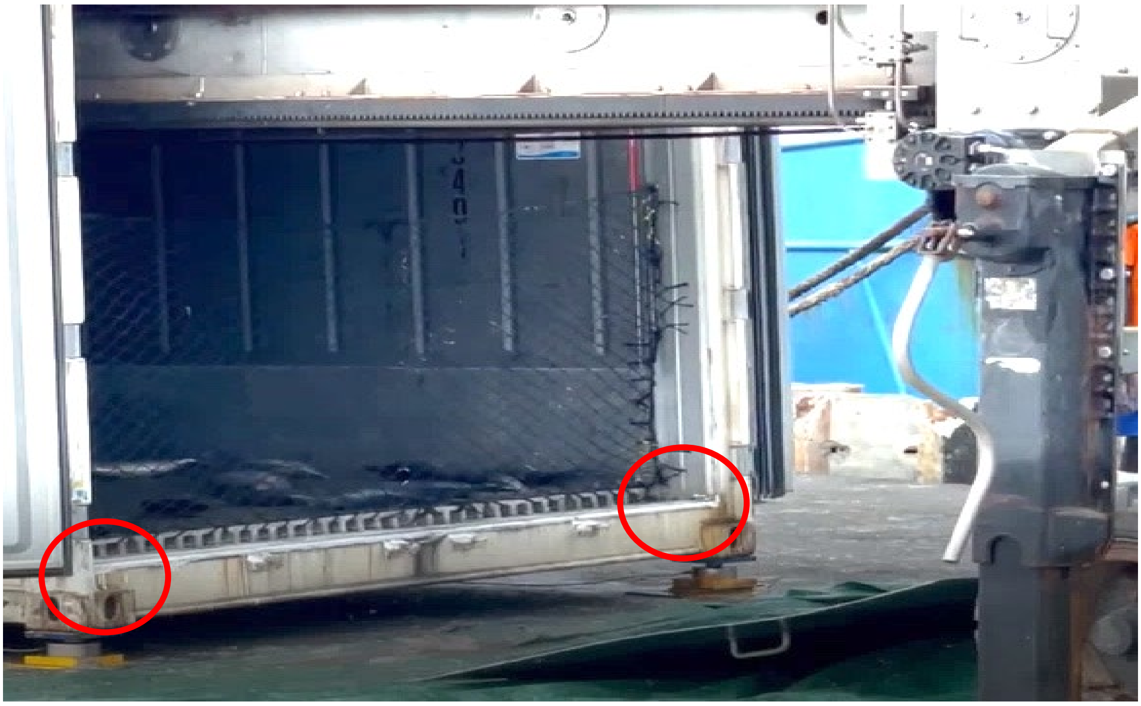
There are several options and requirements for weighing. Hanging scales can be used to weigh each brail coming off the vessel if required, however this can slow down the loading process if the scale does not produce a reading instantly while the brail net is moving. In addition, container weights can be recorded using jack scales placed under each corner of the container when loading is complete.

Figure 17: Load cell used to weigh container during loading to monitor loading weight

Source: Cynthia Wickham

Load cells are placed under each corner prior to loading the container so that container weight can be monitored during loading until the required weight limit is reached.

Figure 18: Load cells being used during container stuffing



Source: (c) Cynthia Wickham

Plug in

Star loader operations in Noro are supported by a yard that contains 100 plug-in points on a concrete pad.

FIGURE 19: PLUG IN AREA AT MAIN PORTS AUTHORITY WHARF, CLOSE ACCESS TO WHARF AND CONTAINER STORAGE YARD

Source: (c) Cynthia Wickham

Electricity is provided to the plug-in area by a 1-Megawatt generator (picture below) capable of powering more than what is currently being used.

FIGURE 20: GENERATOR AND ISO FUEL TANK

Source: (c) Cynthia Wickham

FIGURE 21: BREAKER UNITS CONNECTED TO GENERATOR AND PLUG IN YARD

Source: (c) Cynthia Wickham

Shelter

Rain tends to delay unloading, so if a shelter of some sort can be made, that ensures no down-time from poor weather unless it is extreme. It is appreciated that the nature of the operation with a swinging basket of fish may be hard to work around for shelter, but this is nevertheless something to be considered.

Why two loaders in Noro?

There have been over 10 years of experience with the use of star loaders in Noro. The key determinants for the number of loaders needed are:

- the number of vessels using them;
- the size of the wharf where they operate; and
- investment and operating costs.

In purely operational terms, rather than any consideration of the financial implication and viability, there are good reasons to have two loaders as an operational standard besides the obvious of operational backup in case of maintenance issues, for the following reasons:

- increasing size of PS vessels in the region; and
- facilitation of sorting.

Bigger sized PS are increasing in the region, such as the Spanish (2 400t carrying capacity) and some Korean ones (1 800t). These vessels can unload from two hatches at once to the bow and stern of the main mast; in such situations, having two loaders operating simultaneously accelerates the unloading.

FIGURE 22: TWO STAR LOADERS SET UP READY FOR UNLOADING TWO HATCHES ON LARGER VESSELS

Source: (c) Cynthia Wickham

As discussed above, loaders per se are not designed for sorting. However, and considering the ease of mobility and storage of the "Mark II" units (especially where space is limited), it would be beneficial to have 2 units positioned back-to-back with a platform between the two hoppers for receiving the mixed tuna, sorting them by species and then continue with loading into either of the 2 containers units. This operation would take more than the recommended 1hr per container for loading, however this would not delay the fish coming out of the vessel. Rather, it would take additional time to fill two containers at once. Issues to consider in this case, would be the estimated breakdown onboard and the likelihood of evenly filling two containers at once so as not to have one container open and fish exposed to temperature abuse longer than the other. Equally such an arrangement would require sufficient labour and dock space.

4.4 Key learnings

The Star loader operation provides an efficient unloading alternative to transshipment, with reduced unloading times and the added marketing advantage of being able to ship containers to various cannery markets/destinations. In the case of Noro, the support system of the operation is one of the strengths, with the operator having a unique partnership with Maersk Shipping, allowing for all needed spares and supplies to be on hand for the team to use when needed and the operator having established in-house workshops.

If such an operation were to be replicated in a remote shipping location such as Majuro, a partnership/relationship with shipping services would be imperative to ensure costs are recovered as, ultimately the shipping service gains from the freight costs. While the aim of increasing containerisation in Majuro is part of the upgrading strategy and is operational feasible, there are likely to be commercial, geographical and infrastructure limitations, beyond just sourcing of tuna loaders.

The main learnings with regards to operational arrangements and feasibility are:

- Containerisation will likely be complementary to the carrier trade, which will be, for the foreseeable future, the key activity in Majuro;
- Carriers will continue due to the other benefits they generate (bringing supplies, salt, parts, crew, etc);
- Based on the regional experience, the success of containerisation is predominantly based on the operator having a unique and solid partnership with container shipping operators;
- The South African-made "Star loaders" are the region's most widely used tuna container loaders;
- The use of "Star loaders" has the main advantage of making the process faster, which has many domino-type effects on the vessel's ability to complete unloading faster and the tuna's thermal efficiency and transport quality:
    - Star loaders do not facilitate sorting;
    - Star loaders do increase the speed of stuffing containers and prevent containers to be fed/stuffed by gravity along with water/melt, which causes huge blocks of frozen fish for processors when containers arrive at canneries;
    - Star loaders work best with fish pre-sorted onboard (not always possible in smaller older vessels) so that containers can be sent to canneries with different species/size requirements;
    - Operating two Star loaders at once off a sorting platform can facilitate sorting and accelerate the unloading of bigger vessels with hatches aft and stern of the main mast, but would require double the investment of a single loader;
- Star loaders are not vital for the operation of a cold store;
- It is fundamental to have all the spares and supplies needed to be on hand when needed and the operator to have established in-house workshops;
- The recommended model is the Mark II.

5 Regulatory and market access considerations relevant to containerization

There are regulatory and market access aspects of containerisation that need to be considered for Majuro that will also have an impact on the feasibility of containerisation machine acquisition.

5.1 Containerisation and IUU fishing

MIMRA identified that the key exposure to IUU that containerisation provides is based on the lack of a clear definition of “landing" in key documentation such as FAO PSMA (Port State Measures Agreement) and IPOA IUU. MIMRA delegates were key to the incorporation of the term landing in the definitions of the FAO Voluntary Guidelines for Transshipment adopted in 2022, and explicitly included containers in the definition of landing.

While an increase in direct transfers of fish from catching vessels to containers has been observed in different regions of the world, these transfers are variously termed “transshipment in transit” or "transshipment to container" that take place mostly in customs-bonded ports, without fisheries inspections or any reporting on the landing or transshipment of volumes and species transferred. This practice deliberately blurs the line between landing and transshipment. Authorities in the final port of unloading of the containers do not have clarity whether the catch has been previously landed or not, and no effective PSM may be applied at any point. In these cases, catch enters the supply chain without any fisheries inspector ever having seen the fish and without any monitoring and control.

This significantly increases the risk of misreported fish caught fish entering the seafood supply chain, when the fish is directly “transferred” to containers without any monitoring and control. With the growing number of parties to the PSMA and with strengthened port State measures all around the globe, certain industry actors could choose this practice as one way to transfer fisheries products into the market without monitoring or control.

Therefore, it is important to recognise that containerisation is an activity directly linked to landings, and as such, under the controls of MIMRA’s Port State Measures.

5.2 The European Union market access

A key principle of the European Union regulatory framework is that import rules for fish and fisheries products are harmonized, meaning that the same rules apply in all the European Union countries. For non- European Union countries, the European Commission is the partner that defines import conditions and certification requirements. The two main regulations affecting fish and fishery products seek, among other objectives, to protect final consumers' health, and to prevent products originating from Illegal, Unreported and Unregulated (IUU) fishing activities entering the European Union markets.

Under these regulations all the fishing products must be captured, manipulated, elaborated, transported, and delivered following standards that are established by European legislators, considering European realities, and addressed to European citizens. While there are two “technical” regulatory sets framing certification (food safety and IUU) and a trade one (Origin) that the exporting country needs to comply with, the most complex requirements are with food safety, so it is fair to say that the “main” authorisation requirement in place is for food safety certification.

5.2.1 Sanitary eligibility

Presently there are approximately 100 countries authorised for exports of fish and fishery products, of which around 55 are also authorised for aquaculture products and 13 for live bivalve molluscs. the Marshall Islands is not one of these countries.

The authorisation to export to the European Union is granted based on Regulation (EC) No.882/20048 that defines the concept of equivalence as "the capability of different systems or measures to meet the same objectives, and the term equivalent means different systems or measures capable of meeting the same objectives". The concept of equivalence was designed to provide a structure for use by the European Union member states for areas not covered by specific harmonised rules, as well as where controlling internal markets are carried out by mutual recognition. Yet as a corollary, food imported for sale in the European Union must comply with the relevant requirements of EU food law.

Presently, only fish landed and containerised in the Marshall Islands loses its eligibility for the European Union market even if processed later in the European Union authorised country from the sanitary perspective. As an example, Taiwanese PS (*Taiwan Province of China is a* European Union *authorised country*) can tranship in Majuro's lagoon to a Panamanian carrier (*Panama is the European Union authorised country*), and that fish can be processed in Bangkok (*Thailand is a* European Union *authorised country*) for the European Union market. Yet, if it touches the conveyor of a loader in Majuro's wharf, even a few minutes before entering a refrigerated container, as the_Marshall_Islands is not an authorised country for exports to the European Union, the fish loses "eligibility", and it cannot be processed in Thailand to go to the European Union afterwards (although it could be sent to other markets).

Yet, under transshipment (*defined by the* European Union *as in between two vessels*), if the vessels are from the European Union -authorised countries and are listed as approved by the flag states, it does not matter where it happens and there is no requirement for a port state such as the Marshall Islands to be an authorised country.

The implication of these requirements is that if that fish is landed and containerized in the Marshall Islands then the country must be the European Union -authorised if fish is to be canned for the European Union market.

While the Marshall Islands has advanced substantially in regards its authorisation status, the EU requires MIMRA to document the process of approval of an establishment. This has not been forthcoming since the alleged interest by local operators to become the European Union approved established has not been matched with the necessary level of investments.

5.2.2 The European Union IUU catch certification

In the case of containerisation, the European Union IUU Catch Certificate is to be signed by the flag state (*independently from where the fish was caught and/or was landed*). Yet, if the product is stored (*containers are a form of temporary storage*) and exported from the Marshall Islands as the port state, the European Union IUU regulation requires that the sanitary competent authority (CA) provides a statement of non-processing for the fish in the container.

However, as discussed above, if the port /storage state is not the European Union authorised country from the sanitary perspective, that non-processing statement is not valid and the product in the containers is not eligible for sale in the European Union.

In the case of transshipment, the port state fisheries CA, has only to sign Section 7 of the European Union IUU Catch Certificate verifying that the transshipment was legally authorised, and they can do that independently of their European Union sanitary status.

The processing establishment in any European Union authorised country (like Thailand or Viet Nam) must separate this non- European Union eligible fish from the European Union eligible fish as part of their requirements. This is to be verified by both the sanitary and the fishery authorities of those countries.

Understandably the canneries and processing establishments have clear preferences and pay more for fish containerized in the European Union -authorised countries.

6 Financial analysis

6.1 Introduction

This section of the report will focus purely on the financial analysis of the operational efficiencies of loading machines that can derive value for the industry of the Marshall Islands. While the financials are the focus of this analysis section, the broader sustainability and community impact a star loader machine could have in the Marshall Islands cannot be ignored, especially if such a machine increases the containerization and brings more product to the shores of the Marshall Islands.

Furthermore, it is noted that the financial analysis is not a broader economic analysis. What this means is that the addition of a star loader will have a broader economic impact on the communities and the Marshall Islands economy overall which is not the subject of this analysis/report, which focuses solely on the financials of operating a star loader machine. For example, some potential economic impacts that could be realised with the implementation of a star loader, that are not covered in the financials within this section are:

1. Increase in vessel fishing activity due to shorter time to unload between trips.
2. Increase in landings on the Marshall Islands due to the operational unloading efficiencies of a star loader.
3. Increase in economic activity in the community due to a potential increase in pay to workers operating the star loaders and more profitability to the boats that are landing in the Marshall Islands.
4. Overall increase in containerization of tunas landed on the Marshall Islands.
5. Increase in revenue to the Marshall Islands government due to an increase in port activity.

Although some of these broader impacts are not completely ignored in the financial analysis, we make no assumptions that they will occur, rather the analysis presents ranges of what those impacts would look like on the model when implemented. One direct example of this is an increase in landings and containerization on the Marshall Islands. The analysis looks at a range of increase in the sensitivity analysis from 4.2 percent (current landings), through a two, four, eight, and twelve times multiple of those landings for a potential projection range of those landings.

With that in mind, the financial analysis section has been focused on the operational efficiencies of containerization using star loaders within the status quo of "now" to evaluate the financial justification for the purchase and operation of one or two of the machines. We do not assume any changes to the future of the industry and rely on those changes to justify such an investment.

6.2 Methodology and approach

When conducting financial analysis in the seafood industry there are two main approaches that need to be assessed. The first approach is through efficiencies in the value chain functions themselves and improvements to such functions that can derive financial benefits for the stakeholders. An example of this is the addition of the star loader and the value chain efficiencies that will be derived from such a machine. For this report this type of approach is referred to as the "apples to apples." Meaning we are comparing the same fundamental value chains, just making one of the parts of the value chain more efficient.

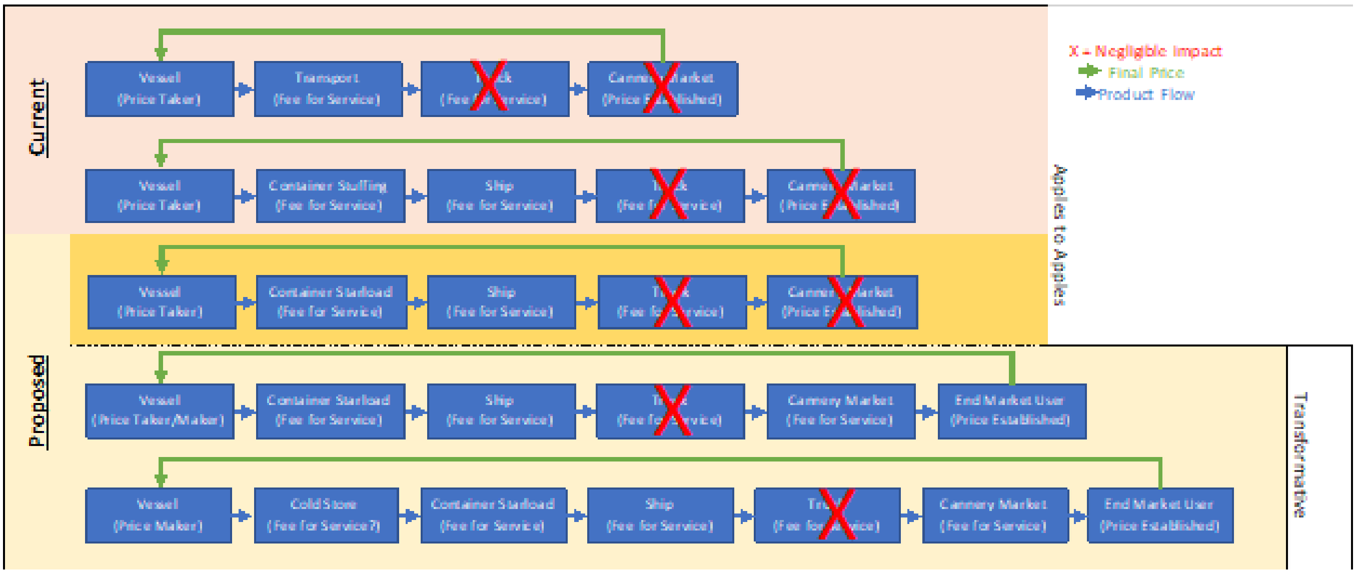
The second approach to be explored in the analysis is the price of the underlying commodity. This methodology focuses on shifting where the value chain functions are physically in the chain and how that change can affect how the commodity (in this case PS tuna) is brought to market and priced. These types of shifts tend to be more disruptive because they fundamentally change how a commodity is bought and sold – and the pricing of the commodity at that transaction point. An example of this is an ability to store product closer to production during a high-volume time of year when prices are low and sell that product later in the year when the price may be high. Another example is the containerization of product in Majuro so it can be shipped to multiple ports. In the report this value chain shift is referred to as the "transformative" model. It is usually these fundamental shifts in market dynamics that create foundational change in industry – these shifts also tend to be more disruptive and riskier. You can think of the difference between the two as the Amazon effect; when a supply chain is massively disrupted by technology and a new route to market for consumers is built. In contrast, an apples-to-apples comparison would be to set up a new self-checkout counter in a grocery retail store. While that model will be new and innovative, it is not changing how people buy and sell groceries, they still go to the grocery store.

For this report, the focus is simply on the value addition that can be derived through the addition of one- or two-star loaders in the Marshall Islands and the models in which the machinery could be financed (apples to apples). While we do not dig into the financials of the transformative model, we do however, lightly touch on this approach as it could be created through the addition of more containerization in the Marshall Islands.

6.3 Value chain construction and comparison

As explained earlier there are two main supply chains that dominate the Marshall Islands purse seine industry. First and foremost is the transport of product via carrier ships. These carriers unload product in the lagoon of the Marshall Islands and transport it directly to Bangkok or other canneries to purchase and process. To be clear: this is the most direct and efficient way to move PS fish from vessel to cannery and the most efficient way to bring product to market, i.e. canneries. The problem with this is the quick to market conditions which makes the pricing in this chain supply driven – the more you fish the more you get paid, with minimal control of product pricing from the vessel to cannery. This value chain is shown on the top of Figure 4 labelled as "Current" and equates to 303 996 Mt of tunas in 2019.

FIGURE 23. VALUE CHAIN COMPARISON DIAGRAM



Source: Authors' own elaboration

The second supply chain, which is much less dominant (15 764 Mt in 2019) is when the product is landed and containerized in the Marshall Islands. This supply chain is slower to market but derives the most benefit for the Marshall Islands overall. Bringing the product ashore provides for more employment opportunities and data collected by the Marshall Islands as well as other benefits for the port overall. This supply chain is important for the upgrading strategy. Even more specifically, container loading in Majuro would lead to poverty reduction, job creation, food, and nutrition security by improving the economic, social, and environmental sustainability. So, the following analysis is focused on how this could be accomplished utilizing public and/or private funds and the potential for this type of project to lead to a transformative industry model.

6.4 Assumptions

Most of the assumptions in this analysis were produced through one-on-one field interviews directly with industry stakeholders in the Marshall Islands and discussions with stakeholders in other comparative value chains. Assumptions were also derived from the Macfadyen et al 2022[28]. A list of assumptions can be found in Table 4 to Table 6 below.

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[28] Op. cit.

TABLE 4 FINANCIAL ANALYSIS ASSUMPTIONS

Assumption *(all values in USD)*	Low	Med	High	Unit
Tons of tuna per container	23	**25**	27	Tons / container
Staroaders - Loading Time	1	**1**	1	Hours / container
Normal Loading Time	2	**3**	4	Hours / container
Frequency of Container Ships Leaving Port	2	**2**	2	weeks
Number of Staff to Unload Containers	4	**5**	5	People
Average Wages for Unloaders	3	**3**	4	Hourly Wage
Electricity Costs / Container	75	**80**	85	Per day
Shipping rates from Majuro to Bangkok	5000	**6000**	7000	Per Container
Shipment Clearance in Bangkok	240	**240**		Per Container
Pre-cooling	75	**80**	85	Container per day
Movement of Containers Around the Yard	160	**180**	200	Per container
Port and Stevedore Clearance	330	**345**	360	Per container
Depreciation of Starloaders	25	**20**	15	Years
Cost ranges for Carrier Transport to Canneries in Bangkok	240	**295**	350	Per MT
Costs for stuffing a container	50	**50**	50	Per MT

Source: Authors' own elaboration

TABLE 5 CAPITAL EXPENDITURE (CAPEX) ASSUMPTIONS

CAPEX *(all values in USD)*	Cost	Unit
Starloader	487750	Per Each Starloader
Frieght, Brokerage, Duties	46500	For 2
Assembly	77200	For 2
Small Tools and other items to operatate machine	10000	For 2
Contigency	10%	Of total costs

Source: Authors' own elaboration

TABLE 6. LOAN TERM ASSUMPTIONS

CAPEX Loan	Amount	Months
Rate (APR)	8%	
Terms (Years)	5	60

Source: Authors' own elaboration

As seen above in Table 4 we have developed a range of assumptions on the low, medium, and high levels based on ranges expressed during the interviews. While some of these assumptions had single industry touchpoints, some were derived through multiple sources. If the interviews contained a range, we expressed that in the high and low numbers with the average of the figures being the medium. When only two figures were given, we used a simple average to find the medium figure. When only one figure was given, we simply used that figure for high medium and low.

Capital expenditures assumptions seen in Table 5 were acquired through direct quotes other than the small tools and other items (a21) and the contingency (a22). These were developed through the first-hand industry knowledge of the consultants in developing similar supply chains. Also note, the contingency is on the total costs of capex and a low contingency was given since most of the costs are in the star loader machine itself, which does not have a large variation in cost. Finally, note that the quotes given for the star loader was for two machines. Although the unit itself was priced by-machine, the shipping and assembly was done as a total for two. In order to derive the CAPEX for one machine, a 60percent multiplier was used of the shipping and assembly for one unit. This can be seen in the CAPEX analysis in the next section.

6.5 CAPEX & loan requirements

As outlined in the Capital Expenditures assumptions (Table 5) and loan term assumptions (Table 6) , the CAPEX Table (Table 7) defines the costs associated with investing in one or two star loader units. As expressed above, the freight brokerage and duties (a19) and Assembly (a20) were not broken down by unit so an assumption of a 60 percent% of the cost was used to derive the total cost of one Unit seen below. We also note that we did not budget any infrastructure costs as most of the infrastructure is already in place to house one of these units. We do, however see contingency covering any costs that could be incurred, such as electricity hook up or any type of housing structure of shade for the unit to protect it from the sun and elements.

TABLE 7 CAPEX FOR 1- OR 2-STAR LOADERS

Capital Expendatures	Assumptions	CAPEX (2 Units)	CAPEX (1 Unit)
Container Infrastructure			
Concrete Pad		$ -	$ -
Electricity Grid		$ -	$ -
Management Software & Hardware		$ -	$ -
Starloaders			
Units (2)	a18	$ 975,500.00	$ 487,750.00
Frieght, Brokerage, Duties	a19	$ 46,500.00	$ 27,900.00
Assembly	a20	$ 77,200.00	$ 46,320.00
Loading Supplies			
Food Safety Supplies		$ -	
Small Tools and Equipment	a21	$ 10,000.00	$ 6,000.00
Contingency (10%)	a22	$ 110,920.00	$ 56,797.00
Total		**$ 1,220,120.00**	**$ 624,767.00**

Source: Authors' own elaboration

Based on the assumptions, the total landed and assembled costs for a single Star loader unit is USD 624 767 and for two units it will cost USD 1 220 120. Based on these high costs, we had to assume a loan was necessary to finance the unit and cash on hand was not available for direct investments. Therefore, our analysis had to factor in a 5-year business loan at an interest rate of 8percent. While these are general rates used for the analysis, the credit worthiness of the local industry stakeholders and availability of cash was not assessed due to the sensitivity of these types of discussions in business.

TABLE 8 LOAN COSTS 1 UNIT

Loan Costs 1 Units	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Avg Interst Payment
Payment		$156,476.93	$156,476.93	$156,476.93	$156,476.93	$156,476.93	
Interest		$ 49,981.36	$ 41,461.71	$ 32,260.50	$ 22,323.18	$ 11,590.88	$ 31,523.53
Principle		$106,495.57	$115,015.21	$124,216.43	$134,153.74	$144,886.04	
Balance	$ 624,767.00	$ 518,271.43	$ 403,256.22	$ 279,039.79	$ 144,886.04	$ -	

Source: Authors' own elaboration

TABLE 9 LOAN COSTS 2 UNITS

Loan Costs 2 Units	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Avg Interst Payment
Payment		$305,586.93	$305,586.93	$305,586.93	$305,586.93	$305,586.93	
Interest		$ 97,609.60	$ 80,971.41	$ 63,002.17	$ 43,595.39	$ 22,636.07	$ 61,562.93
Principle		$207,977.33	$224,615.52	$242,584.76	$261,991.54	$282,950.86	
Balance	$ 1,220,120.00	$ 1,012,142.67	$ 787,527.15	$ 544,942.40	$ 282,950.86	$ -	

Source: Authors' own elaboration

Seen above in Table 8 and Table 9, financing of these units is an expensive endeavour with average interest for one unit of USD 31 523.52 and USD 61 562 for two and yearly payments of USD 156 477 and USD 305 587, respectively. When conducting the analysis, we factored these amounts into both costs (direct expenses) and cash flows (principal loan payments) which makes up a significant amount of the costs associated with operating the Star loaders. As seen in the next section, we review the operational costs of owning and operating the machine before exploring the financial benefits.

6.6 Operational costs of star loaders

As defined in the CAPEX analysis above, there are significant expenses associated with the purchasing of the Star loader units. Specifically, the direct expense of the interest payments and the amortization of the CAPEX over time. The good news is the units themselves are an asset which can be reflected in the balance sheet and therefore be amortized through the depreciation expense. For this analysis we used a depreciation timeline of 15– 25 years which is an average rate of 20 years. This means over the course of 20 years the machine itself will erode to a value of zero on a balance sheet and a new one will need to be purchased. While the hope is to get much more usage and time out of the unit, the analysis used conservative numbers.

The analysis found that the largest areas of expense in purchasing this unit are depreciation, interest, and electricity/maintenance. For the maintenance and electricity usage budget we used a conservative USD 5 000 per year per unit. While this cost seems high, it will start low and increase over the life of the machine as parts begin to wear out. Furthermore, the depreciation expense is always added back into the operational cash flows at the end of the year, and the reality of depreciation is that depreciation expense itself covers the maintenance and repairs of the machine yearly – allowing it to last well past the anticipated depreciation time frame. Table 10 and Table 11 below outline these expenses per machine:

TABLE 10. OPERATIONAL EXPENSE FOR PONE STAR LOADER MACHINE

Operational Costs 1 Machine	Assumptions	Low		Average		High	
CAPEX 1 Machine	CAPEX	$	624,767	$	624,767	$	624,767
Electricity, Maintenance & Repairs	a26	$	(5,000)	$	(5,000)	$	(5,000)
Yearly Loan Payments	CAPEX	$	(156,477)	$	(156,477)	$	(156,477)
Yearly Depreciation	a15	$	(24,991)	$	(31,238)	$	(41,651)
Yearly Operatinal Costs		**$**	**(186,468)**	**$**	**(192,715)**	**$**	**(203,128)**

Source: Authors' own elaboration

TABLE 11. OPERATIONAL EXPENSE FOR PURCHASING TWO STAR LOADER MACHINES

Operational Costs 2 Machines	Assumptions	Low		Average		High	
CAPEX 2 Machines	CAPEX	$	1,220,120	$	1,220,120	$	1,220,120
Electricity, Maintenance & Repairs	a26	$	(10,000)	$	(10,000)	$	(10,000)
Yearly Loan Payments	CAPEX	$	(305,587)	$	(305,587)	$	(305,587)
Yearly Depreciation	a15	$	(48,805)	$	(61,006)	$	(81,341)
Yearly Operatinal Costs		**$**	**(364,392)**	**$**	**(376,593)**	**$**	**(396,928)**

Source: Authors' own elaboration

As seen in the tables above, one unit will cost USD 186 468 to USD 203 128 in yearly expenses and two units will cost USD 364 392 to USD 396 928, with the largest variable to both of those expenses being yearly depreciation. Finally, to justify the expense of the Star loader units these expenses will need to be covered by the operational efficiencies outlined in the section below.

6.7 Operational efficiencies of star loaders

The entire reason for this report boils down to this section: the operational efficiencies a star loader can bring to the containerization of PS tuna landed in the Marshall Islands. The good news: there are efficiencies derived from the use of star loaders. Specifically, the time it takes to pack a container is significantly reduced. This will decrease the time each boat stays at the dock and the labour needed to pack these containers. While fundamentally this detracts from the idea of gaining employment in the Marshall Islands, it can be assumed that more products will be landed based on the boats being able to spend more time at sea and therefore there will be an increase in containerization on island. Although that is the hope, the increase of containerization and landings in the Marshall Islands is not modelled in our apples to apples comparison of the supply chain.

As seen in Table 4 above, specifically in assumptions a4 and a5, there is a major difference in the time it takes to load a container with the utilization of a star loader. With a range from 2-4 hours to manually load a container, this can be reduced to 1 hour per container with no deviation in the time to load. This equates to a 50– 75percent reduction in labour with an average of 67percent as articulated in Table 12 below and a USD 7 008 to USD 36 015 reduction in labour expenses yearly based on the total landings of tuna for containerization in the Marshall Islands of 15 764 Mt (assumption # a1). This also means there can be a potential increase in pay for those who load the containers, due to the efficiency of their work. The largest variable in the time to stuff containers is based on the number of containers stuffed and the load weight of each container. For the purposes of this report, we focus on the average assumptions and modelling as the most accurate to what is occurring in the Marshall Islands.

TABLE 12. EFFICIENCIES GAINED BY STAR LOADERS

Efficiencies Gained by Star Loaders	Assumptions	Low		Average		High	
Current Containers Stuffed in Majuro	a1, a3	$	584.00	$	631.00	$	686.00
Current Time to Stuff Containers (Hours)	a5, a7	$	4,672.00	$	8,518.50	$	13,720.00
Starloader Time to Stuff Containers (Hours)	a4, a7	$	2,336.00	$	2,839.50	$	3,430.00
Current Wages Paid to Stuff Containers	**a8**	**$**	**14,016.00**	**$**	**27,685.13**	**$**	**48,020.00**
Starloader Wages Paid to Stuff Containers	**a8**	**$**	**7,008.00**	**$**	**9,228.38**	**$**	**12,005.00**
Income from Efficiencies in Loading Containers		**$**	**7,008.00**	**$**	**18,456.75**	**$**	**36,015.00**
			50%		**67%**		**75%**

Source: Authors' own elaboration

6.8 Profit / Loss analysis of operating star loaders

While star loaders gain significant operational efficiencies the real constraint of the Marshall Islands is the current volumes landed and containerized. Without a significant increase in containerization the analysis has shown no financial justification for investing in star loaders unless one takes on the risk of increasing the of volumes landed and hopes that the star loaders will help to increase those landings. As articulated in Table 13 and Table 14, an investment of USD 624 767 in one star loader will result in a yearly cash flow loss of USD (167 113) to USD (179 460). While the investment in two-star loaders will yield a loss of USD (356 384) to USD (360 913). Fortunately, there are two different ways of reading this analysis. One is the cash flow modelling as seen in Table 13 and Table 14. This factors in both principal and interest in the loan payments and ignores the underlying asset on the balance sheet. Another way to look at this is if cash is on hand to pay for the unit, then the only operational expenses would be depreciation and maintenance only. Table 15 and Table 16 model the investment without the loan equated into the expenses. When not equating loan payments into the financial equation of investing into a star loader, the financial justification, while still negative, makes more sense. Ranging from a loss of USD (22 983) to USD (10 636) per year it is closer to break even.

TABLE 13. FINANCIAL JUSTIFICATION FOR 1 STAR LOADER MACHINE

Financial Justification 1 Machine (Depreciation & Loan Payments)	Assumptions	Low		Average		High	
CAPEX 1 Machine	CAPEX	$	624,767.00	$	624,767.00	$	624,767.00
Income from Efficiencies	a1, a3, a5, a7, a8	$	7,008.00	$	18,456.75	$	36,015.00
Electricity, Maintenance & Repairs	a26	$	(5,000.00)	$	(5,000.00)	$	(5,000.00)
Yearly Loan Payments	CAPEX	$	(156,476.93)	$	(156,476.93)	$	(156,476.93)
Yearly Depreciation	a15	$	(24,990.68)	$	(31,238.35)	$	(41,651.13)
Yearly Profit / Loss		$	**(179,459.61)**	$	**(174,258.53)**	$	**(167,113.06)**

Source: Authors' own elaboration

TABLE 14. FINANCIAL JUSTIFICATION FOR 2 STAR LOADER MACHINES

Financial Justification 2 Machines (Depreciation & Loan Payments)	Assumptions	Low		Average		High	
CAPEX 2 Machines	CAPEX	$	1,220,120.00	$	1,220,120.00	$	1,220,120.00
Income from Efficiencies	a1, a3, a5, a7, a8	$	7,008.00	$	18,456.75	$	36,015.00
Electricity, Maintenance & Repairs	a26	$	(10,000.00)	$	(10,000.00)	$	(10,000.00)
Yearly Loan Payments	CAPEX	$	(305,586.93)	$	(305,586.93)	$	(305,586.93)
Yearly Depreciation	a15	$	(48,804.80)	$	(61,006.00)	$	(81,341.33)
Yearly Profit / Loss		$	**(357,383.73)**	$	**(358,136.18)**	$	**(360,913.26)**

Source: Authors' own elaboration

TABLE 15. FINANCIAL JUSTIFICATION FOR 1 STAR LOADER MACHINE (DEPRECIATION ONLY)

Financial Justification 1 Machine (Depreciation Only)	Assumptions	Low		Average		High	
CAPEX 1 Machine	CAPEX	$	624,767.00	$	624,767.00	$	624,767.00
Life of the Machine	a1, a3, a5, a7, a8		25		20		15
Electricity, Maintenance & Repairs	a26	$	(5,000.00)	$	(5,000.00)	$	(5,000.00)
Yearly Depreciation 1 Machine	CAPEX	$	(24,990.68)	$	(31,238.35)	$	(41,651.13)
Income from Efficiencies (Yearly)	a15	$	7,008.00	$	18,456.75	$	36,015.00
Yearly Profit / Loss (Depreciation Only)		$	**(22,982.68)**	$	**(17,781.60)**	$	**(10,636.13)**

Source: Authors' own elaboration

TABLE 16. FINANCIAL JUSTIFICATION FOR 2 STAR LOADER MACHINES (DEPRECIATION ONLY)

Financial Justification 2 Machines (Depreciation Only)	Assumptions	Low		Average		High	
CAPEX 2 Machines	CAPEX	$	1,220,120.00	$	1,220,120.00	$	1,220,120.00
Life of the Machine	a1, a3, a5, a7, a8		25		20		15
Electricity, Maintenance & Repairs	a26	$	(10,000.00)	$	(10,000.00)	$	(10,000.00)
Yearly Depreciation 2 Machines	CAPEX	$	(48,804.80)	$	(61,006.00)	$	(81,341.33)
Income from Efficiencies (Yearly)	a15	$	7,008.00	$	18,456.75	$	36,015.00
Yearly Profit / Loss (Depreciation Only)		$	**(51,796.80)**	$	**(52,549.25)**	$	**(55,326.33)**

Source: Authors' own elaboration

Furthermore, when running a sensitivity analysis looking at an increase in landings of transshipment products as seen in Table 17 and Table 18 , if depreciation is the only factor in the expenses of such a machine, it will take doubling the landings of PS tuna on the Marshall Islands to make financial justification for the machine itself and the investments to start to make financial sense. Although this feels obtainable based on the very small percentage of total landings in the Marshall Islands, it is still a large leap to double production immediately upon buying the machine. What this analysis and table does clearly articulate though, is there is a financial model to been seen if landings are increased in the Marshall Islands. This increase can justify the costs associated with purchasing one unit, but not the risk involved in the purchase. The only trouble with such a forecast is the risk one will take on by investing in machinery that does not produce immediate benefit, therefore a lot of exposure for the private sector actor to solely take on a loan and purchase the machine. One could hypothesize that this is main reason no one has invested in such machinery in the Marshall Islands to date.

TABLE 17. SENSITIVITY ANALYSIS OF INCREASING TRANSSHIPMENT LANDINGS AND IMPACT ON FINANCIAL ANALYSIS OF 1 STAR LOADER

Average Operational Costs 1 Machine	Current Landings	2x Current Landings	4x Current Landings	8x Current Landings	12x Current Landings
% of Total Landings	4.20%	8.00%	14.82%	25.81%	34.29%
Depreciation Only	$ (17,781.60)	$ 675.15	$ 37,559.40	$ 111,327.90	$ 185,096.40
Depreciation & Interest	$ (49,305.13)	$ (30,848.38)	$ 6,035.87	$ 79,804.37	$ 153,572.87
Depreciation & Loan Payment	$ (174,258.53)	$ (155,801.78)	$ (118,917.53)	$ (45,149.03)	$ 28,619.47

Source: Authors' own elaboration

TABLE 18. SENSITIVITY ANALYSIS OF INCREASING TRANSSHIPMENT LANDINGS AND IMPACT ON FINANCIAL ANALYSIS OF 2 STAR LOADERS

Average Operational Costs 2 Machines	Current Landings	2x Current Landings	4x Current Landings	8x Current Landings	12x Current Landings
% of Total Landings	4.17%	8.00%	14.82%	25.81%	34.29%
Depreciation Only	$ (52,549.25)	$ (34,092.50)	$ 2,791.75	$ 76,560.25	$ 150,328.75
Depreciation & Interest	$ (114,112.18)	$ (95,655.43)	$ (58,771.18)	$ 14,997.32	$ 88,765.82
Depreciation & Loan Payment	$ (358,136.18)	$ (339,679.43)	$ (302,795.18)	$ (229,026.68)	$ (155,258.18)

Source: Authors' own elaboration

Another key element that comes from this analysis is the question of one machine vs two. Especially in the sensitivity analysis, it becomes clear that adding a second machine, at this time, does not make financial sense. However, it could be interpreted in the analysis, that if landings increase to a much larger level a second machine could be warranted in time.

Key conclusions from the analysis above are:

1. Operational efficiencies do not justify the costs of a star loader machine solely as a private capital investment.
2. Buying a second unit further emphasizes potential loses at time of purchase and therefore from a financial perspective only one unit should be considered for purchase initially.
3. Blended capital (public and private funds) will be necessary to generate financial justification of investing in a star loader in the Marshall Islands and to reduce risk for the private industry to make such an investment.
4. Public contributions to funding are justified on the basis of the wider society and transformative impacts that increased containerization would have in the Marshall

Islands, over and above the financial benefits accruing to the private sector purchasing and operating the star loader.

6.9 Blended finance analysis

As justified in the Marshall Islands value chain analysis and design report,[29] increasing containerization can contribute to the social and environmental Sustainable Development Goals of the United Nations and sustainable development of the Marshall Islands' Blue Economy. However, as seen above it is not in the best interest of the private sector to solely pursue increasing containerization on the Marshall Islands with investments in star loaders based on the current landings in the Marshall Islands and the negative returns such investments would derive. It is however in the private sector's best interest if a certain percentage of costs were subsidized putting a value to the social and environmental impacts of a machine in the Marshall Islands. Therefore, it is recommended a portion of a single star loader machine be subsidized by public type capital to enable the industry to pursue increasing landings of currently transhipped product in the Marshall Islands waters.

This section of the financial analysis looks at different ways to blend capital on the balance sheet, justification of such ways and a defined approach to the blended capital model.

6.9.1 Cost sharing models

There are many ways to pool capital types in a project like this, and this section of the report should be used as a discussion point, not as a suggestion on how these investments can be modelled. The work of finalizing a deal between stakeholders will need to be conducted between stakeholders in the Marshall Islands and all parties would need to discuss and agree to the structure that works best for them.

One way to look at these public capital expenditures are as de-risking investments in the industry to enable private endeavours that are linked to sustainability. This can be done in many ways: grant capital underwriting a purchase or investment, uncollateralized loans given through grants, and/or blended capital / direct subsidies taking on certain costs of a project in the name of a government or sustainability outcomes. Any way it is modelled, the goal would be to reduce project costs to a tolerable risk level that the private sector will co-invest.

In the case of the star loaders in the Marshall Islands, there are three major expenses that should be considered for investment by the public sector that inhibit the ability for the private sector to invest. They are as follows:

1. The Interest Expense
2. The Depreciation Expense

[29] Macfadyen et al, 2022. Op cit.

3. The Loan Principal Payments

These three factors equate to most of the negative cash flow returns on investments made in the star loaders. In our analysis below, each one can be isolated to best analyze the profitability when the government chooses to co-invest in one of these machines. Table 19 to Table 21 below look at three different tiers of co-investment in star loaders based on a blended capital model and the profitability of each one when landings in the Marshall Islands increase.

TABLE 19. COST SHARE MODEL WHEN DEPRECIATION IS SUBSIDIZED

Cost Share	57.53%	$ 323,302			
Average Operational Costs 1 Machine w/Depreciation Subsidized	Current Landings	2x Current Landings	4x Current Landings	8x Current Landings	12x Current Landings
% of Total Landings	4.17%	8.00%	14.82%	25.81%	34.29%
Depreciation Only	$ -	$ 18,456.75	$ 55,341.00	$ 129,109.50	$ 202,878.00
Depreciation & Interest	$ (13,579.60)	$ 4,877.15	$ 41,761.40	$ 115,529.90	$ 189,298.40
Depreciation & Loan Payment	$ (67,406.60)	$ (48,949.85)	$ (12,065.60)	$ 61,702.90	$ 135,471.40

Source: Authors' own elaboration

TABLE 20. COST SHARE MODEL WHEN DEPRECIATION & LOAN INTEREST ARE SUBSIDIZED

Cost Share	79.40%	$ 446,192			
Average Operational Costs 1 Machine w/Depreciation & Interest Subsidized	Current Landings	2x Current Landings	4x Current Landings	8x Current Landings	12x Current Landings
% of Total Landings	4.17%	8.00%	14.82%	25.81%	34.29%
Depreciation Only	$ 6,758.95	$ 25,215.70	$ 62,099.95	$ 135,868.45	$ 209,636.95
Depreciation & Interest	$ (0.00)	$ 18,456.75	$ 55,341.00	$ 129,109.50	$ 202,878.00
Depreciation & Loan Payment	$ (26,791.21)	$ (8,334.46)	$ 28,549.79	$ 102,318.29	$ 176,086.79

Source: Authors' own elaboration

TABLE 21. COST SHARE MODEL WHEN DEPRECIATION, LOAN INTEREST AND PRINCIPAL ARE SUBSIDIZED

Cost Share	98.58%	$ 554,001			
Average Operational Costs 1 Machine w/Depreciation & Loan Subsidized	Current Landings	2x Current Landings	4x Current Landings	8x Current Landings	12x Current Landings
% of Total Landings	4.17%	8.00%	14.82%	25.81%	34.29%
Depreciation Only	$ 12,688.44	$ 31,145.19	$ 68,029.44	$ 141,797.94	$ 215,566.44
Depreciation & Interest	$ 11,913.12	$ 30,369.87	$ 67,254.12	$ 141,022.62	$ 214,791.12
Depreciation & Loan Payment	$ 8,839.90	$ 27,296.65	$ 64,180.90	$ 137,949.40	$ 211,717.90

Source: Authors' own elaboration

What these tables show is:

1. If only depreciation is subsidized by funding 57.53 percent or 323 302 USD of the expense of a star loader, the industry would bear a USD (67 406) loss year on year until volumes increased to 4x their current rate if the industry needed to also bear the expenses of a loan.

2. If depreciation and loan interest (direct expenses) were subsidized by funding a total of 79.40 percent or USD 446 192 of a star loader industry would bear a USD (26 791) loss year on year until volumes increased over 2x their current rate.
3. If depreciation, loan interest and loan principal payments where subsidised the industry would bear no loss for co-investing in a star loader, but subsidies would make up 98.58 percent of the costs of a single star loader.

6.9.2 Blended finance recommendations & financial analysis summary

Based on the analysis conducted above, there are options on how to potentially view the role of public capital injections in the purchase of a star loader. First, would be to not subsidize an asset for the public sector, but co-finance the losses the industry would incur through such investments. This could be achieved by only subsidizing the depreciation and/or the interest rate costs incurred in private sector financing and purchase of such a machine. This would protect the industry from immediate direct loses and incentivize the private sector to increase the landings of product in the Marshall Islands instead of the lagoon to ensure they can make the principal payments on their loan. This approach does not subsidize the asset of the star loader on the balance sheets of the private sector by paying principal on the loans, but only protecting the private sector from the losses of the interest rates charged year on year. This would also help the private sector attract finance since the machine itself is protected from the financial losses seen by its purchase while still keeping the asset intact.

The second recommendation would be to subsidize only the depreciation of the star loader, while this would be riskier for the private sector, if they have the cash available to invest the matching 42.47 percent then they will not be paying interest on their investment (other than a discount rate, which is not a cash loss) nor would they be paying principal payments. This model would work best and keep the costs low for all parties, but requires liquidity from an industry partner, and the willingness of that partner to make such an investment.

Finally, and what is not recommended, is subsidizing all the costs associated with the star loader and pay for principal, interest, and depreciation. But one could argue that this would disincentivize the private industry from increasing the landings in the Marshall Islands since the profitability of the machine would be realized from the time of purchase and commission of the machine.

This leaves the analysis with one main recommendation for moving forward: co-investment between the public and private sector to subsidize the interest and depreciation or just the depreciation of one star loader in the Marshall Islands. The investment will spark incentive for the private sector to increase the landings of tuna in the Marshall Islands and potentially transform the supply chain through shifting the value chain functions and create more value in the Marshall Islands.

6.10 Cost-sharing options

There are many different options for the cost-sharing of the procurement of the star loaders. As suggested above, the financial implications are clear from three different avenues of subsidies, and the recommendation is not to fully subsidize the private sector.

On option would be for the public sector to retain ownership based on contribution to investment costs made (either by Government and/or by FISH4ACP), and to gradually transfer ownership to the private sector based on lease payments for use of the machine. However, this is considered unwise given that the containerisation process is a private sector operation, and the goal should be to link the ownership of the machine directly to private partner(s) to increasing landings and therefore increase profits. Furthermore, it is not possible under FAO rules for FISH4ACP to grant fund MIMRA/government through procurement of a loader.

A second option would be to subsidize interest payments, which in this case would be indirectly subsidizing the banking sector – by reducing their risk in such a purchase. While underwriting is an option, this would need to be done with a bank and open to other companies looking to invest in similar machines to advance the environmental, social, and economic outcomes of implementation such machines. Therefore, for this report, we avoid this type of subsidy as the goal is not to broker the discussions for financing options between the banking and fishing industry sector overall. Instead leaving that to the private sector alone to manage.

A final option for financial justification of public sector financing for such a machine is depreciation costs. If the public sector mitigates the risk of the CAPEX of the machine deprecating faster than the income that could be earned through a cash investment by the private sector, then it will completely mitigate the risk of direct cash loss on the private sector from day 1 of the purchase of the machine and that should give enough incentive to the industry to invest in the machine. The analysis above show that a subsidy is being provided if public funds pay for principle on the machine especially if the machines was on the balance sheet of the private sector. Essentially, the focus of these subsidized costs is on the depreciation and interest of the unit, with ownership remaining in the hands of the private sector.

To review the numbers of such an investment, as seen in Table 19 above a depreciation only cost share model would be approximately 58 percent of the total costs of CAPEX or USD 323 302. For the sake of comparison, figures are provided in Table 23 when public funds provide two-thirds of the investment.

Table 22: Cost share model when 67 percent of the machine is paid with public funds

Cost Share	67.00%	$ 376,520			
Average Operational Costs 1 Machine w/Depreciation Subsidized	Current Landings	2x Current Landings	4x Current Landings	8x Current Landings	12x Current Landings
% of Total Landings	4.17%	8.00%	14.82%	25.81%	34.29%
Depreciation Only	$ 2,926.99	$ 21,383.74	$ 58,267.99	$ 132,036.49	$ 205,804.99
Depreciation & Interest	$ (7,698.89)	$ 10,757.86	$ 47,642.11	$ 121,410.61	$ 195,179.11
Depreciation & Loan Payment	$ (49,817.91)	$ (31,361.16)	$ 5,523.09	$ 79,291.59	$ 153,060.09

Source: Authors' own elaboration

TABLE 23: COST SHARE MODEL HIGH, MEDIUM AND LOW WHEN 67 PERCENT OF THE MACHINE IS PAID WITH PUBLIC FUNDS.

Financial Justification 1 Machine (Depreciation Only)	Assumptions	Low		Average		High	
CAPEX 1 Machine	CAPEX	$	210,595.11	$	210,595.11	$	210,595.11
Life of the Machine	a1, a3, a5, a7, a8		25		20		15
Electricity, Maintenance & Repairs	a26	$	(5,000.00)	$	(5,000.00)	$	(5,000.00)
Yearly Depreciation 1 Machine	CAPEX	$	(8,423.80)	$	(10,529.76)	$	(14,039.67)
Income from Efficiencies (Yearly)	a15	$	7,008.00	$	18,456.75	$	36,015.00
Yearly Profit / Loss (Depreciation Only)		**$**	**(6,415.80)**	**$**	**2,926.99**	**$**	**16,975.33**

Source: Authors' own elaboration

As seen in Table 23, there would be a small yearly profit of USD 2 927 based on the current landings and average cost assumptions, if loan expenses were not realized. What is nice about this, is the extra capital in profits the model could also justify an increase in wages by an average of USD 1.08 per hour per worker if that subsidy did not directly fund the private sector, but instead made a wage mandate of at least USD 1.00 when employing labour for operating the star loader. This would help increase the effectiveness of the grant and establish a USD1.00 (or 29 percent) increase from USD 3.50 to USD 4.50 in hourly wages during the hours of operating the star loader.

Based on this assessment and discussions with local stakeholders the clear financial recommendation of the report is as follows:

- Purchase one star loader under something approximating a 60 percent FAO/FISH4ACP - 40 percent Private sector investment.
- The public sector financing would represent a subsidy of depreciation expense but in practical terms would be a cash contribution at the time of purchase.
- Given the significant contributions made to the private sector a number of conditions should be attached, with a formal and legal agreement reached with the private sector as part of the contribution made by FISH4ACP.

These conditions could/should include the following, all to be negotiated with the private sector and formally agreed:

- While using the machine a USD 1.00 increase in wages would need to be applied to all staff utilizing the machine.
- The private sector would need to repair and maintain the machine and keep it in good working order as a condition of the funds provided by FISH4ACP, or ownership would be recovered from the private sector. Management and maintenance will therefore be the responsibilities of the private sector due to the major contributions of the public sector to subsidize the depreciation costs of the machine. While the operations and schedule of use will need to be defined and agreed to by the private sector partners, the management and oversight of the machine will be by the government, on behalf of FISH4ACP to ensure the proper use and maintenance of the machine.
- The private sector party made the machine available to other parties if required for agreed time periods.

- The private sector, during all usage of the machine, should file a report the week after the end of the usage on the use of the machines indicating dates used, vessels unloaded, number of containers, estimated species breakdown from the unload, the destination of containers, the hours of usage, employees hired to use the machine, and wages paid. As well as operational reporting on scheduled maintenance, type breakdowns and cost of breakdowns if these were to occur will need to be reported during these times or reporting as well.

7 Overall conclusions and recommendations

This report has concerned itself with the operational and financial viability of tuna loading/stuffing machines, focussing on the star loader model manufactured in South Africa and being used in several different tuna ports around the world.

Key conclusions and recommendations are:

- Containerisation will be complementary to the carrier/transshipment trade, which will be, for the foreseeable future the key activity in Majuro. Carriers will continue due to the other benefits they generate (bringing supplies, salt, parts, crew, etc)
- Based on the regional experience (Kosrae and Noro), the success of containerisation is predominantly based on the operator having a unique and solid partnership with container shipping operators.
- The use of loaders has the main advantage of making the process faster, which has many domino-type effects on the vessel's ability to complete unloading faster and the tuna's thermal efficiency and transport quality.
- It is important to have all the spares and supplies needed to be on hand to use when needed and the operator having established in-house workshops.
- The South African-made “star loaders” are the region's most widely used loaders. Noro has derived great benefits of them.
- Star loaders are good for loading containers, but they are not designed to sort tuna, and they are not vital for the operation of a cold store.
- The recommended model is the “Mark II” and from an operational perspective it makes sense to have 2 loaders on site. However, given the investment costs of the machines, and the fact that it will take time to gradually increased containerisation in the Marshall Islands, the financial analysis has shown that investing in one loader only initially would be viable.
- The private sector is unlikely to invest in a star loader without public financial support given the risks and capital outlay involved. However, from an economic perspective, the use of loaders to support containerisation in the Marshall Islands would generate broader social and economic benefits which could be transformative. This provides justification for public sector support to investments.
- Given the investment costs involved and FAO procurement rules which prevent FISH4ACP financing a loader for provision to Government/MIMRA, it is proposed that FISH4ACP finance around 60 percent of the investment cost of one star loader, with the private sector financing the other 40 percent. Exact percentages need to be agreed between the parties.

- The public sector financing would represent a subsidy of depreciation expense but in practical terms would be a cash contribution at the time of purchase.
- Given FISH4ACP financial contributions, and with ownership of the machine being in private sector hands, conditions should be placed on the private sector with regards to maintenance, wages paid to labour used, some trial use by other parties, and reporting. Again, the exact conditions need to be negotiated between the parties.

This report presents the results of the tuna container loader feasibility study in the Marshall Islands.

FISH4ACP is an initiative of the Organisation of African, Caribbean and Pacific States (OACPS) aimed at making fisheries and aquaculture value chains in twelve OACPS member countries more sustainable. It contributes to food and nutrition security, economic prosperity and job creation by ensuring the economic, social and environmental sustainability of fisheries and aquaculture in Africa, the Caribbean and the Pacific.

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